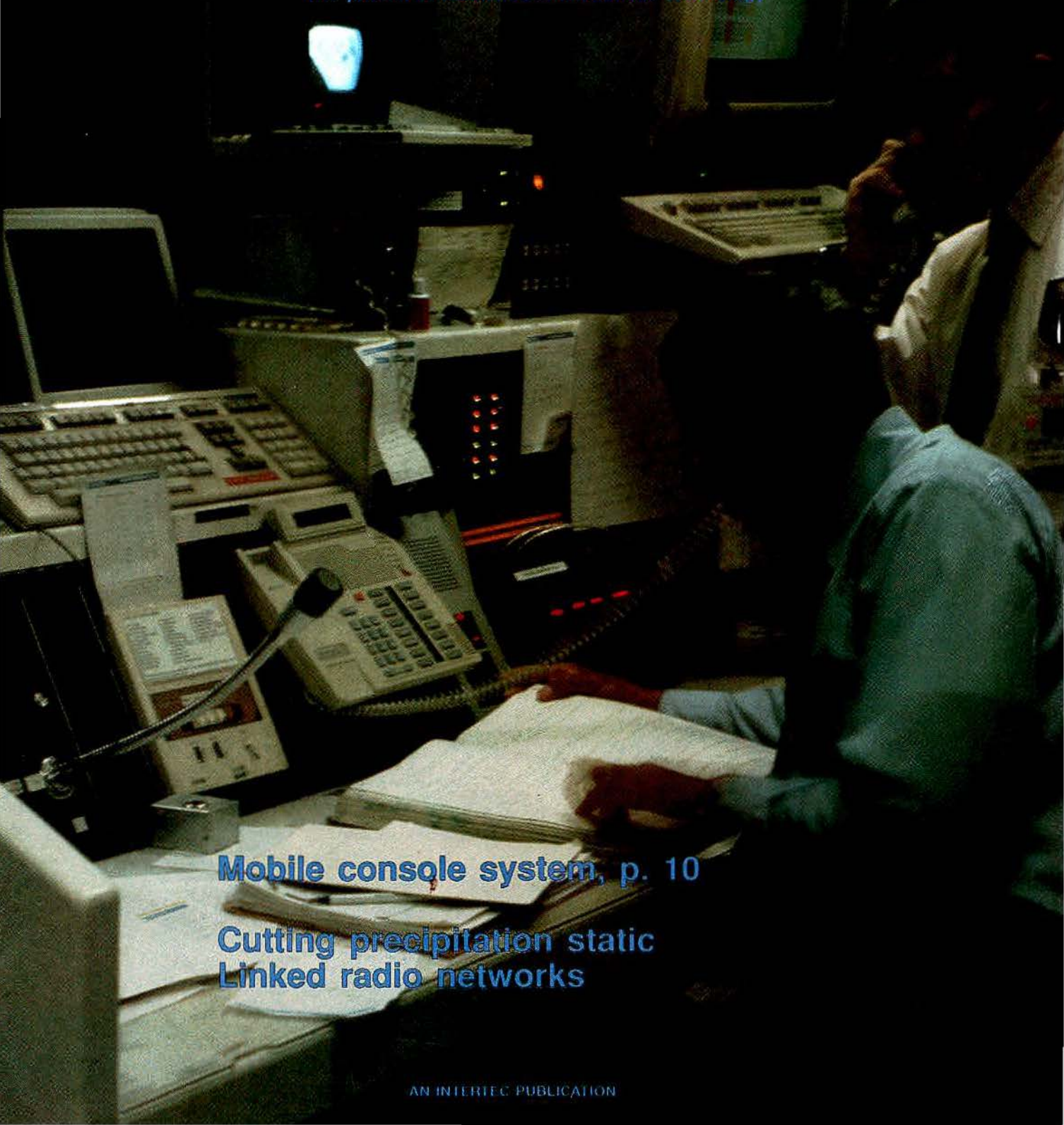


January 1993/\$3.00

# Mobile Radio Technology

The journal of mobile communications technology



**Mobile console system, p. 10**

**Cutting precipitation static  
Linked radio networks**

AN INTERTEC PUBLICATION



# Announcing Midland's new 800MHz mobiles. Much more than simply LTR-compatible!

*Now you can get Midland LMR quality and value in an LTR-compatible radio. These Midland trunked/conventional mobiles enable users to take full advantage of the operational features and flexibility inherent in the LTR trunked system protocol.*

■ **Programmable for up to 10 systems.** Each system programmable for up to 10 LTR-trunked groups or 10 conventional 800 MHz channels.

■ **User-friendly controls.** Big, bright 2-digit LED display for System/Group, plus TX/CALL, SCAN and AUX lights (CALL light can also indicate Priority calls). Controls include two auxiliary functions for horn alert, scan delete/restore, and/or talk-around. Trunked supervisory tones include Volume Set and Clear-to-Talk beep. Microphone hang-up control of scan and conventional channel monitoring is optional.

■ **Talk-Around** for trunked/conventional systems programmable by group/channel, or switch enabled.

■ **TX Timeout Timing** for trunked and conventional operation, programmable 0.5-10 minutes.

■ **Priority Calling.** Trunked mode programmable for two priority ID's plus group ID's. Priority ID's won't affect interconnect calls in progress.

■ **System/Group scan versatility:**

- Programmable for three different types of trunked and conventional system scan.
- Programmable to let user delete and restore trunked systems/groups and conventional systems/channels.
- Trunked and conventional scan modes programmable for "floating" revert (last system/group received), or for "fixed" revert.
- Programmable conventional mode priority channel scanning (separate from fixed/floating revert).

■ **Programmable "transpond"** automatically acknowledges in-range trunked mobiles to caller.

■ **Optional DTMF microphone** provides trunked/conventional telephone interconnect capability. In trunked systems, a Free-System Ringback feature provides automatic queuing and channel access.

■ **Busy Channel Lockout.** Programmable for three types of BCLO on conventional channels.

■ **E<sup>2</sup>PROM programming** via PC interface or cloning.

■ **Data Capability.** Optional interface kits.

■ **Meets MIL 810 C/D, shock and vibration** with optional support bracket kit.

For complete information, call:  
**1-800-MIDLAND, Ext. 1690**



**MIDLAND LMR**  
LAND MOBILE RADIO





# The 10-site radio controller



Gooseneck  
microphone  
optional

Clock/audio-level/  
cross-mute display  
optional

## Vega's C-5111 10-line/4-frequency console

Vega's Model C-5111 compact, easily rack-mounted, ten-line/four-frequency radio control console provides instant PTT, timed mute, and other most-needed features. This tone-format console allows you to quickly select one or any combination of up to 10 remote base stations. A second speaker allows you to monitor (with individual volume controls) any combination of those 10 stations that are not already selected for TX/RX control. Instant PTT switches allow immediate response to a call on a particular "selected" or "unselected" line, without disturbing the programming of the "selected" simulcast group or line.

Standard features available on the cost-effective and versatile C-5111 console include:

- **SELECTED** switches for selecting any combination of lines for transmitting and receiving
- **UNSELECTED** switches for monitoring any combination of unselected lines

- **TX ALL (simulcast) switch** for selecting all lines for both transmit and receive
- **RX ALL switch** for monitoring all unselected lines
- **Separate speakers and volume controls** for "selected" (TX/RX) and "unselected" (RX-only) audio
- **GROUP SELECT switch** for easy selection of TX/RX line combinations
- **TIMED MUTE switch** to mute "unselected" audio temporarily
- **Separate volume controls** for each "unselected" line
- **Instant-PTT switches** for each line
- **Line-activity LEDs** (function on all lines, selected or not)
- **Heavy-duty 120/240-V<sub>ac</sub> power supply** (also runs on 12 V<sub>dc</sub>)

### Options

- **DCA-3 external three-line adapter** for DC-format lines

- Gooseneck and desk microphones, headsets, footswitch
- DTMF pad
- Cross mute
- Clock, audio-level bargraph, and cross-mute indicators
- Rack-mount kit

The C-5111 has the flexibility to accommodate most any multiline console requirement. Call 1-800-877-1771 (toll-free) now for full details on the C-5111 console.



a MARK IV company

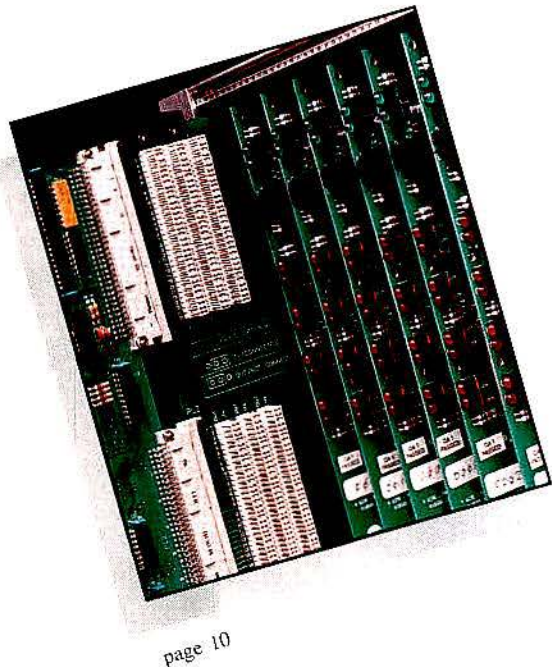
Signaling Products Group

9900 East Baldwin Place  
El Monte, California 91731-2294  
Telephone: (818) 442-0782  
Toll-Free Telephone: 800-877-1771  
Fax: (818) 444-1342  
FaxBack: (818) 444-2017  
Toll-Free FaxBack: 800-274-2017

Circle (4) on Fast Fact Card



## features



### 10 Base console system uses digital control

*Frits P. Van Enk*

Standard voice-frequency and data components combine with software and peripheral devices to offer a digitally controlled console system with expansion capacity and flexibility.

### 24 Static discharger wicks cut precipitation static noise

*Michael E. Norton*

Adapted from aircraft applications, static discharger wicks for towers and antennas are designed to reduce radio noise caused by corona discharge and precipitation static. Improvements as great as 40dB have been noted.

### 44 How to configure linked radio networks

*A.O.J. Woodfield*

Wide-area radio communications system coverage can be achieved with multiple sites linked into a network. Here are some considerations for choosing between half-duplex and full-duplex configurations.

## departments

### 4 Editorial

Scanning . . .

### 6 Calendar

1993 events.

**On the cover:** Jackson Wyatt, operations controls supervisor (left) and David Pagan, an assistant, in the Port Authority of New York and New Jersey's World Trade Center operations control center ("Seven-seven desk"), New York.

### 8 Technically speaking

How do you spell VSWR?

### 61 News

Publicity campaign, views of future highlight Mobile Communications Marketplace.

### 63 Regulating technology

SMR operators file multiple license applications.

### 64 New products

Ericsson GE Mobile Communications, Shinwa Communications of America and Motorola are the "Readers' Choice."

### 69 Literature

### 70 Feedback

Not enough frequencies available.

### 71 People

### 72 Letters to the editor

Combining antennas.

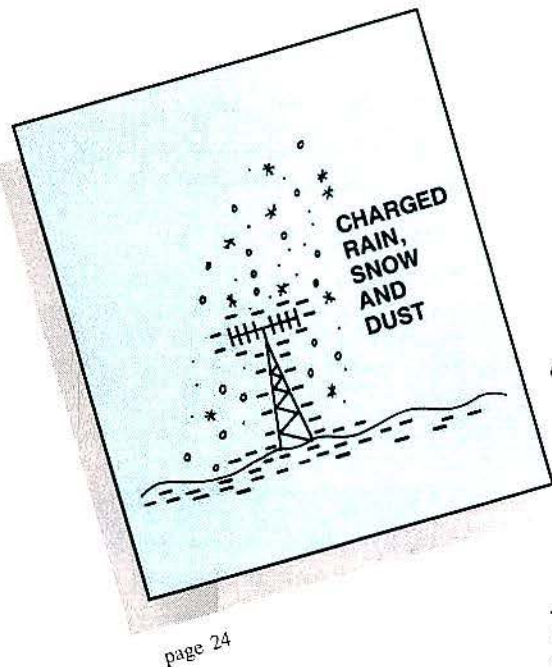
### 73 Classified ads

### 88 Ad index/hot line

Find advertisers quickly.

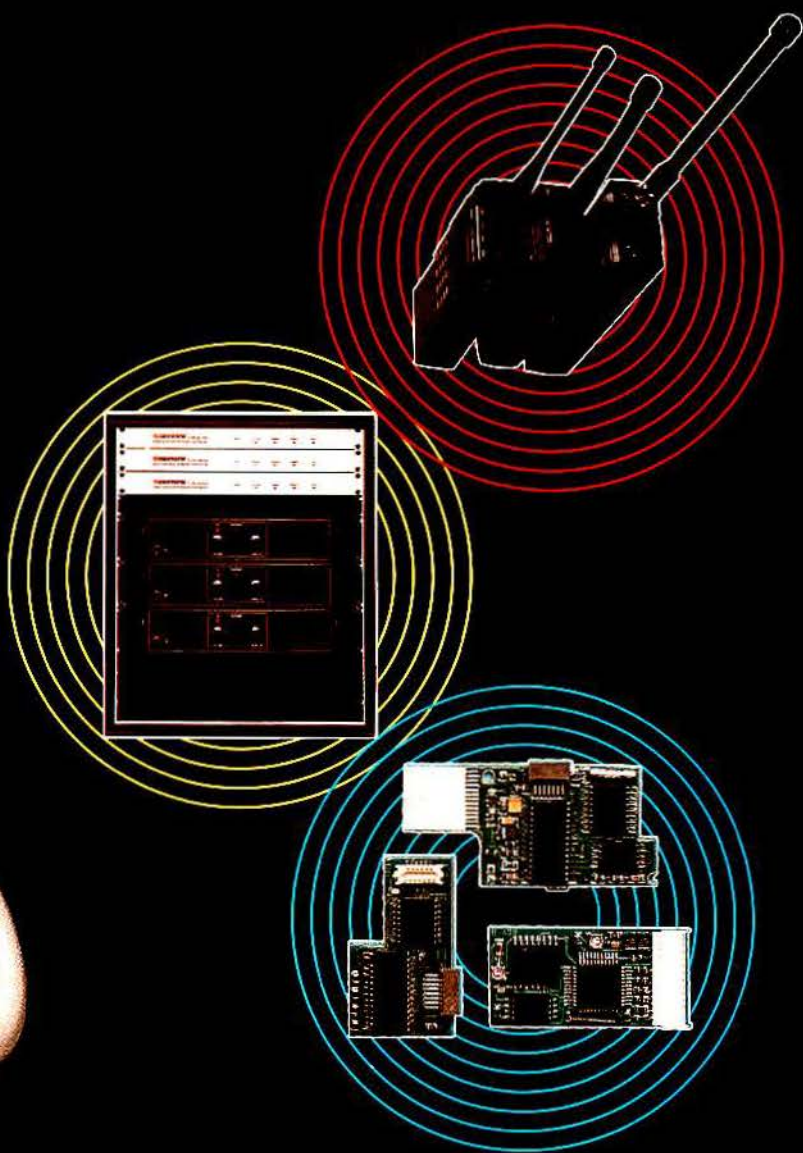
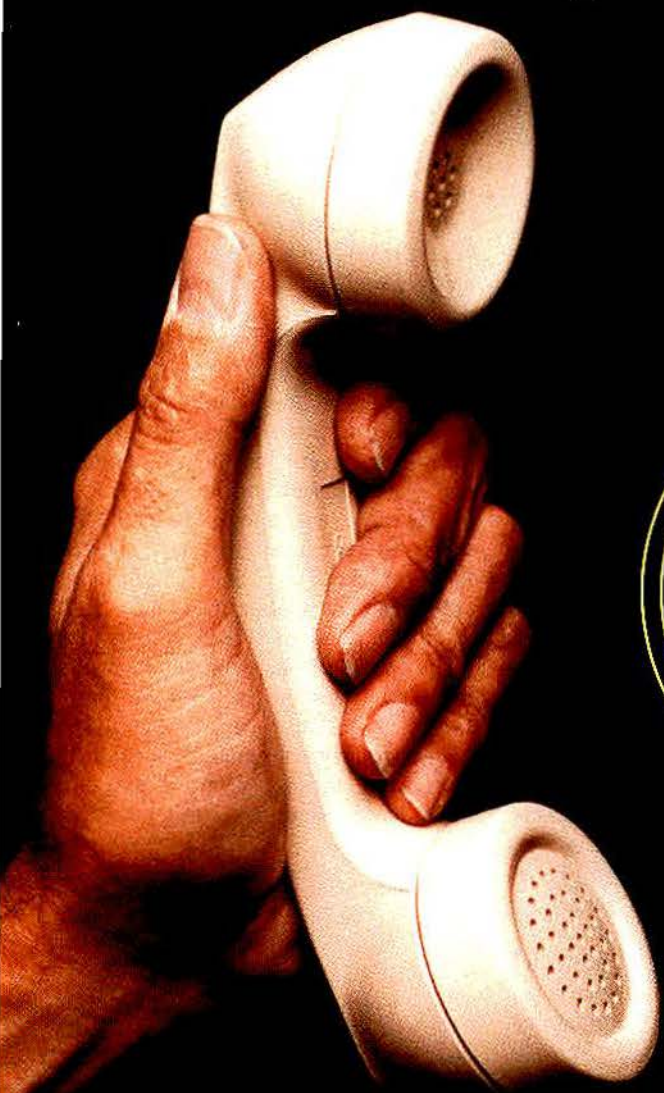
### 89 What do you think?

©1993 Mobile Radio Technology (ISSN 0745-7626) is published monthly for free to qualified individuals by Intertec Publishing Corporation, 9800 Metcalf, Overland Park, KS 66212-2215. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address change to MOBILE RADIO TECHNOLOGY, P.O. Box 12960, Overland Park, KS 66282-2960.





# Selectone SmarTrunk™ Radiotelephone Trunking



## Low cost trunking on **ANY** frequency band

Now you can economically build your OWN trunked radio system or upgrade your existing UHF or VHF system to trunked operation. SmarTrunk from Selectone allows radio trunking on up to 16 channels at up to 16 different sites. Designed for radiotelephone interconnect applications, SmarTrunk provides many of the same features as cellular and existing 800 MHz trunking systems—but at a fraction of the cost.

- Up to 1,100 subscriber capacity
- Call privacy and system security
- DTMF or dial pulse compatibility
- Compatible with many portable and mobile radios
- Supports mobile-to-mobile calling
- Easy to program and operate

FOR COMPLETE DETAILS, CALL OR WRITE TODAY:

**Selectone**

Selectone Corporation • 23278 Bernhardt Street, Hayward, CA 94545  
Toll Free: 1-800-227-0376 • Phone: (510) 887-1950 • Fax: (510) 887-4011

Circle (5) on Fast Fact Card



## Scanning . . .



### SMR industry changes

The face of the specialized mobile radio (SMR) industry may change rapidly if the FCC approves applications for expanded service by existing system operators.

The expansion plans include low-power, low-site digital systems with frequency reuse within large cities and high-power, high-site regional digital networks. Low-power, low-site digital systems first became known as ESMR systems, the name given by Fleet Call, Rutherford, NJ. *E* stands for *enhanced*.

Some of the applications include requests to place transmitters closer together than the rules allow, a process known as short-spacing. The FCC has been allowing short-spacing based on two procedures. Some operators favor one procedure over another, leading to a dispute among some of them.

To allow time to resolve the dispute, the FCC has *frozen* short-spacing applications that rely on the more liberal of the two procedures, meaning it will accept no more such applications for the time being. It will, nonetheless, process the applications it already has.

To give an example of how extensive some of the expansion plans are, Fleet Call has filed applications for more than 700 5-channel digital SMR sites located at least 25 miles from the center coordinates for an 800MHz waiting list area.

Transit is asking for 233 800MHz SMR transmitter sites in 12 states,

using all of the frequencies for which it currently is licensed in Atlanta and that can be reused at the new site on a non-short-spaced basis.

Some operators are filing applications to expand their service area, to protect their existing service area or both.

What results from these new business tactics depends on what the FCC decides about the applications. If a sizable number are granted, the face of the SMR industry at the end of 1993 will be considerably different from its face as the year begins.

\* \* \*

### 220MHz: waiting, waiting . . .

The 220MHz-222MHz band has been silent for more than a year, waiting for its new occupants, private radio users, to arrive.

As it stands, the FCC has conducted a lottery to assign construction permits to license applicants for local channels. Applicants for nationwide channels have to wait because the commission is reconsidering whether to assign them by lottery.

How fast the local licenses are going to be issued remains to be seen.

At present, only one manufacturer, SEA, Mountlake Terrace, WA, is known to offer FCC type-accepted 220MHz equipment.

Maybe, by the time you read this, the first permits will have been issued. And maybe not. Truly, the matter of 220MHz licenses is a waiting game.

\* \* \*

### Social event

The Radio Club of America's awards banquet has become the land mobile radio industry's social event of the year.

November 1992's banquet at the

New York Athletic Club drew an overflow attendance that included the most well-known land mobile radio industry personalities, along with figures from the broadcasting industry and amateur radio hobby.

Interest in the Radio Club is growing for a number of reasons, including the opportunity for like-minded people to get to know one another and to continue established friendships during a day's socializing before the banquet.

An afternoon program of talks on communications and broadcasting topics and the evening's speeches and awards presentations combine with the social aspects to make the annual meeting an event that many members and guests attend year after year.

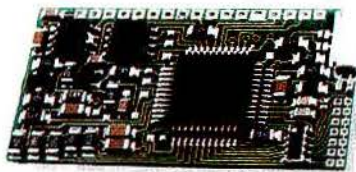
One more reason for extra interest in the most recent banquet is that Fred M. Link's nearly 25-year tenure as club president was set to end the month after the banquet. Fred, who is our magazine's industry consultant and a focal point for the land mobile radio industry because of his extensive manufacturing background, consulting work and support of trade associations, has become the club's president emeritus.

—Don Bishop



# OUR SCRAMBLERS ARE BEST AT GIVING PEOPLE STATIC.

## Crypto Voice Plus™ Scramblers from Transcript.



Actual size

International has the proven line of products you need.

Our unique narrowband analog scrambling with digital control, gives Crypto Voice Plus (CVP™) units greater range and superior audio performance over plain digital systems. And our modules' small size make them compatible with virtually all radios and systems.

Transcript CVP scramblers are packed with the features you'd expect from the world leader in voice privacy and signaling. Such as lost radio stun and over-the-air programming and control. When it comes to signaling, no other system offers so much in such

Whether you want security against casual listeners or a sophisticated system designed to defeat the most determined interception efforts, Transcript

a small size—ANI, selective calling, status reporting, emergency with acknowledgement and more.

So give your people the best in crystal clear communication, and the other guy a lot of static. Get Crypto Voice Plus from Transcript to suit all of your radio applications.

**FOR MORE INFORMATION, CONTACT  
TRANSCRIPT INTERNATIONAL AT  
1-800-228-0226, EXT. 12.**



**TRANSCRIPT**  
INTERNATIONAL

**THE WORLD LEADER IN VOICE PRIVACY AND SIGNALING TECHNOLOGY.**

1620 North 20th Street, Lincoln, NE 68503 (402) 435-4400 FAX (402) 435-6780

Circle (6) on Fast Fact Card



## January

25-26—**AMTEX**, the American Mobile Telecommunications Association's Marketing and Technology Conference and Exposition, Sheraton, New Orleans. Contact: 202-331-7773.

## March

- 2-4—**Cellular Telecommunications Industry Association Winter Meeting and Exposition**, Dallas Convention Center, Dallas. Contact: 202-785-0081.
- 17-19—**Western States Regional Conference Associated Public-Safety Communications Officers Meeting**, Hyatt Regency, Phoenix. Contact: Deborah L. Overton, 602-256-1029.
- 21-24—**Energy Telecommunications and Electrical Association**, New Orleans Convention Center, New Orleans. Contact: 214-235-0655.
- 23-25—**International Mobile Communications Expo/Spring**, Anaheim Convention Center, Anaheim, CA. Contact: 303-220-0600.

## April

- 19-22—**Supercomm and Telocator Wireless Conference**, Georgia World Congress Center, Atlanta. Contact: 800-326-8638.
- 21-23—**North Central Regional Conference Associated Public-Safety Communications Officers Meeting**, Radisson Inn Bismarck, Bismarck, ND. Contact: Lyle V. Gallagher, 701-224-2127.

## May

- 12-14—**Annual Mobile Communications Conference**, sponsored by the National Association of Business and Educational Radio (NABER), Hyatt Regency Hotel, San Antonio. Contact: 800-759-0300.
- 16-19—**East Coast Regional Conference Associated Public-Safety Communications Officers Meeting**, Cavalier Hotel, Virginia Beach, VA. Contact: Bill Marriott, 804-247-8431.
- 18-20—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Meadowlands Hilton, Secaucus, NJ. Contact: George D. Gaul, 908-290-1128; fax 908-290-1932.
- 26-28—**RadioComm**, Metro Toronto Convention Centre, Toronto. Contact: Lisa La Prairie, 613-233-4888.

## June

29-July 1—**Utilities Telecommunications Council Annual Meeting**, San Antonio Marriott Rivercenter and Convention Center, San Antonio. Contact: Rita Clark, 301-621-7802.

## July

18-22—**Forestry-Conservation Communications Association**, Jackson, WY. Contact: Don Pfohl, 602-644-3166.

## August

8-13—**Associated Public-Safety Communications Officers 59th National Conference**, New Orleans Convention Center, New Orleans. Contact: 800-824-1850.

## September

- 21-23—**International Mobile Communications Expo/Fall**, Philadelphia Convention Center, Philadelphia. Contact: 303-220-0600.
- 28-Oct. 1—**Mobile Communications Marketplace**, New Orleans Convention Center, New Orleans. Contact: Telocator, 800-326-8638.

## October

- 6-9—**Industrial Telecommunications Association Annual Meeting**, La Quinta Hotel, La Quinta, CA. Contact: Barbara J. Levermann, 703-528-5115.
- 12-13—**SMR/Private Carrier Management Conference**, Loews Coronado Hotel, San Diego, CA. Contact: 202-331-7773.
- 16-21—**International Association of Chiefs of Police Annual Conference**, Cervantes Convention Center, St. Louis, MO. Contact: 703-836-6767.

## November

19—**Radio Club of America Awards Banquet**, New York Athletic Club, New York. Contact: 201-652-6811.



## Mobile Radio Technology

The journal of mobile communications technology

### EDITORIAL

Don Bishop, *Editorial Director*  
Nancy Campbell, *Senior Associate Editor*  
Ellen Payne, *Associate Editor*  
Dawn Stillinger, *Graphic Designer*  
Harold Kinley, *CET, Contributing Editor*

### INDUSTRY CONSULTANT

Fred M. Link

### REGULATORY CONSULTANT

Alan S. Tilles, Esq., *Partner; Meyer, Faller, Weisman & Rosenberg P.C., Washington, DC*

### EDITORIAL ADVISORY BOARD

Gene A. Buzzi, *President, Omnicom Telecommunications Engineering, Tallahassee, FL*  
R. James Evans, *Communications Consultant, East Lansing, MI*  
Gary David Gray, *P.E., Chief Telecommunications Engineer, Orange County Communications, Orange, CA*  
Frederick G. Griffin, *P.E., President, Frederick G. Griffin P.C., Lynchburg, VA*

S.R. McConoughey, *P.E., Mobile Communications Consulting, Gaithersburg, MD*  
Art McDole, *Salinas, CA*  
Stuart F. Meyer, *Land Mobile Consultant, Vienna, VA*  
Herb Sachs, *Herb Sachs Consulting, Bowie, MD*  
Leon Spencer, *Radio Engineering Systems, Exxon Company USA, Houston, TX*  
Dr. Gregory M. Stone, *Vice President, Special Projects, Live Oak Systems, McLean, VA*  
Raymond C. Trott, *President, Raymond C. Trott Consulting Engineers, Irving, TX*  
William A. Wickline, *P.E., Mentor, OH*

**CORRESPONDENCE:** Editorial and advertising correspondence should be addressed to P.O. Box 12901, Overland Park, KS 66282-2901, 913-341-1300, fax: 913-967-1904.

**MOBILE RADIO TECHNOLOGY** provides technical information to dealers, community repeater operators, specialized mobile radio operators, conventional and cellular RCC and WCC, mobile radio equipment manufacturers, manufacturers' reps, distributors, engineering/consulting firms, national/state/local government, military agencies, public safety agencies, transportation companies, petroleum/energy products companies, public utilities and others allied to the field.

**SUBSCRIPTIONS: MOBILE RADIO TECHNOLOGY** is circulated without charge in the United States by name and title to personnel who are responsible for sales, operation or maintenance of mobile radio equipment. Non-qualified subscriptions in the United States are \$30 per year; in Canada, \$36 per year; and in other countries, \$40 per year. Foreign airmail optional at an additional \$65 per year. Single copies are \$3 plus postage and handling; back issues, \$5 postpaid. Adjustment necessitated by subscription termination at single copy rate. Allow six to eight weeks for change of address or for new subscription. Send subscription information to: P.O. Box 12968, Overland Park, KS 66282-2968.

**PHOTOCOPY RIGHTS:** Permission to photocopy for internal or personal use is granted by Intertec Publishing Corporation for libraries and others registered with Copyright Clearance Center (CCC), provided the base fee of \$2 per copy of article is paid directly to CCC, 21 Congress St., Salem, MA 01980.



\$3.00 + 0.00

Audited circulation.

**INTERTEC PUBLISHING**

© 1993 by Intertec Publishing. All rights reserved.



# Talk is Cheap.

So is privacy.

## STONE SQUELCH AND SCRAMBLING IN ONE CHIP.

We make a chip that combines tone squelch and scrambling, called the MX375 Pvt SQUELCH™ encoder/decoder. On our MX P1084 tone board, 38 individually coded sub-channels are made private, where there were only tones before.

Privacy for the cost of tones, or tones for the cost of privacy — both for the price of one.

Like good fences, privacy makes better neighbors. To mend the fences in your neighborhood, call toll-free: 1-800-638-5577.

**FACTORY INSTALLATIONS NOW  
AVAILABLE!**



## MX·COM, INC.



## How do you spell VSWR?

By Harold Kinley, CET

Of course, there is only one way to spell VSWR, but there are many ways to represent antenna (or other RF load or source) mismatches using different

measuring units.

For example, occasionally you will see the terms *return loss*, *reflection coefficient*, *percent reflected power* and *reflected-to-forward power ratio*. It is enough to confuse Confucius!

But do not despair. There is a way to

convert among the various units without using calculus.

► **VSWR**—Probably the most widely used and best understood measuring unit used by radio communications technicians is voltage standing wave ratio (VSWR).

When a manufacturer specifies that a certain antenna operates over a certain frequency range at a VSWR of 1.5:1 or better (less), we immediately know that this is a good match—the system will operate efficiently with minimal wasted power.

► **Return loss**—When the forward power on a transmission line equals 100W and the reflected power equals 25W, the return loss is determined by the following formula:

$$\begin{aligned} R_L &= 10 \log (P_F / P_R) \\ &= 10 \log (100 / 25) \\ &= 10 \log (4) \\ &= 10 \times 0.602 \\ &= 6.02 \text{ dB} \end{aligned}$$

where

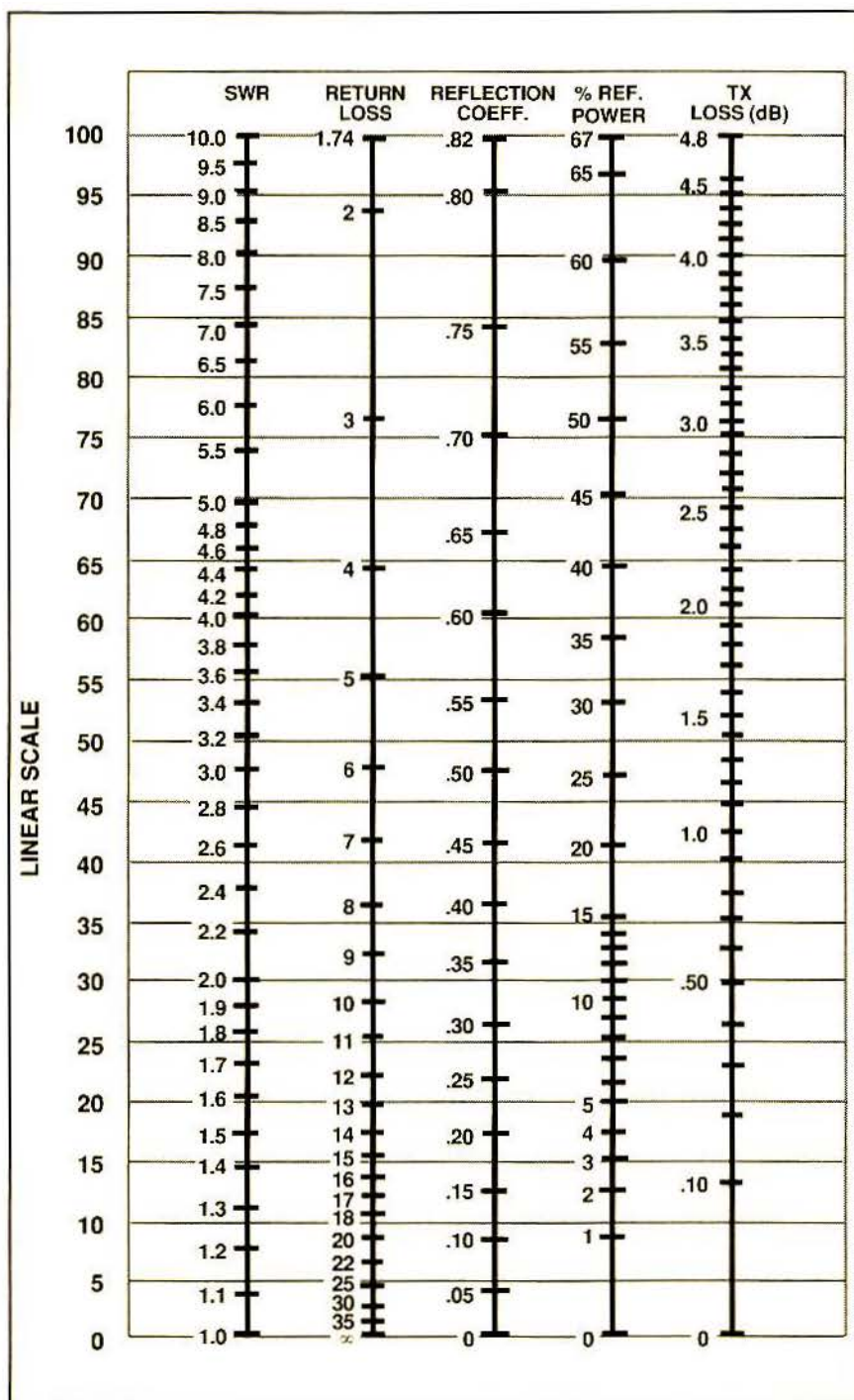
$$\begin{aligned} R_L &= \text{return loss in decibels} \\ P_F &= \text{forward power in watts} \\ P_R &= \text{reflected power in watts} \end{aligned}$$

Because of transmission line loss, the VSWR at the antenna is worse than what is measured at the transmitter, and the same difference applies for every unit of measure.

It is easy to convert return loss at the transmitter to return loss at the antenna because the transmission line loss usually is stated in terms of decibels per 100 feet (dB/100ft.).

For example, if the line loss is 2dB and the return loss at the transmitter is

*(continued on page 58)*





# Save Your Batteries For When You Really Need Them.

Use X-Tra Talk, from Centurion.



**N**ow you can make sure your batteries are ready when you need them.

It's simple. When operating from your vehicle, make it standard procedure to power

your two-way portable with X-Tra Talk (patent pending), the battery eliminator from Centurion.

X-Tra Talk plugs into your vehicle's lighter (or any other 12-volt source) to give you hassle-free operation for as long as you need to talk. No worries about power drain. No problems with related weakening of signal.

And best of all, no surprise battery failure down the line when you really need to use them.

Because X-Tra Talk gives you: • Maximum power output from your radio • Extended battery life • Protection against reverse polarity and current surges • Compatibility with virtually all popular two-way portables.

So why drain your radio's battery when you can tap into your vehicle's power source? Get X-Tra Talk and eliminate the frustration of batteries failing when you need them most.

X-Tra Talk. Another bright idea from Centurion, your two-way portable power source.

Call us toll-free at 800-228-4563 for the name of our distributor nearest you. And ask about our full line of batteries and power packs.



**CENTURION INTERNATIONAL, INC.**  
*Power When You Need It.*



# Base console system uses digital control

*Standard voice-frequency and data components combine with software and peripheral devices to offer a digitally controlled console system with expansion capacity and flexibility.*

By Frits P. Van Enk

The days when mobile systems consisted of a base station with a rooftop antenna serving a single-digit number

Van Enk is engineering manager at GPT - Sepac Pty. Limited, a radio communications system company based in Springvale, Victoria, Australia.

of mobiles on a single channel (a "base and six" system, for example) are behind us. Instead, a range of modern techniques and system features are available to support a far more effective system design.

Modern frequency synthesizer and process control technology allow the design and manufacture of complex, yet economical, mobile radio transceivers.

Trunking technology offers wide-area coverage. Selective calling and data transmission improve communications speed and quality. Access to the public switched telephone network (PSTN) is readily available.

Cellular telephone base station control system technology generally has been in the forefront of mobile radio developments. At the same time, private mobile radio system base station control technology generally has been lacking. Several factors contribute to the situation.

- Base control systems usually last longer than mobile units.

- Mobile fleet expansion and improvement are relatively simple, but many base control systems are inflexible and difficult to expand.

Large systems, such as those used by police agencies, fire departments and ambulance services, have suffered because most base control systems have been increasingly complex, inflexible and unreliable. Thus, overall system performance may be limited by weaknesses in base control equipment that cannot take full advantage of powerful features and capabilities offered by modern mobile radios. The use of a digitally controlled console system (DCCS) with universal hardware and software elements makes it easier and more economical to make custom base controls to meet individual system requirements. (Because the DCCS is compatible with common RF base station technology, RF system components are not described in this article.)

## System concept

Rather than being designed for a spe-

## Abbreviations

**DCCS**—digitally controlled console system.

**PSTN**—public switched telephone network.

**E/M**—input/output. Literally "ear/mouth," E/M is derived from telephony: ear (input to device); mouth (output from device).

**DVSU**—digital voice switching unit.

**CPU**—central processing unit.

**codec**—coder-decoder.

**CCIR**—International Radio Consultative Committee.

**EEA**—Electronics Engineering Association (U.K.).

**EIA**—Electronic Industries Association.

**ZVEI**—Zentralverband der Electrotechnischen Industrie (Germany).

**PABX**—private automatic branch exchange.

**VSWR**—voltage standing wave ratio.

**PA**—power amplifier.

**RF**—radio frequency.

**PCM**—pulse code modulation.

**PC**—personal computer

**AT**—Advanced Technology (an IBM trademark).

**selcal**—selective calling.



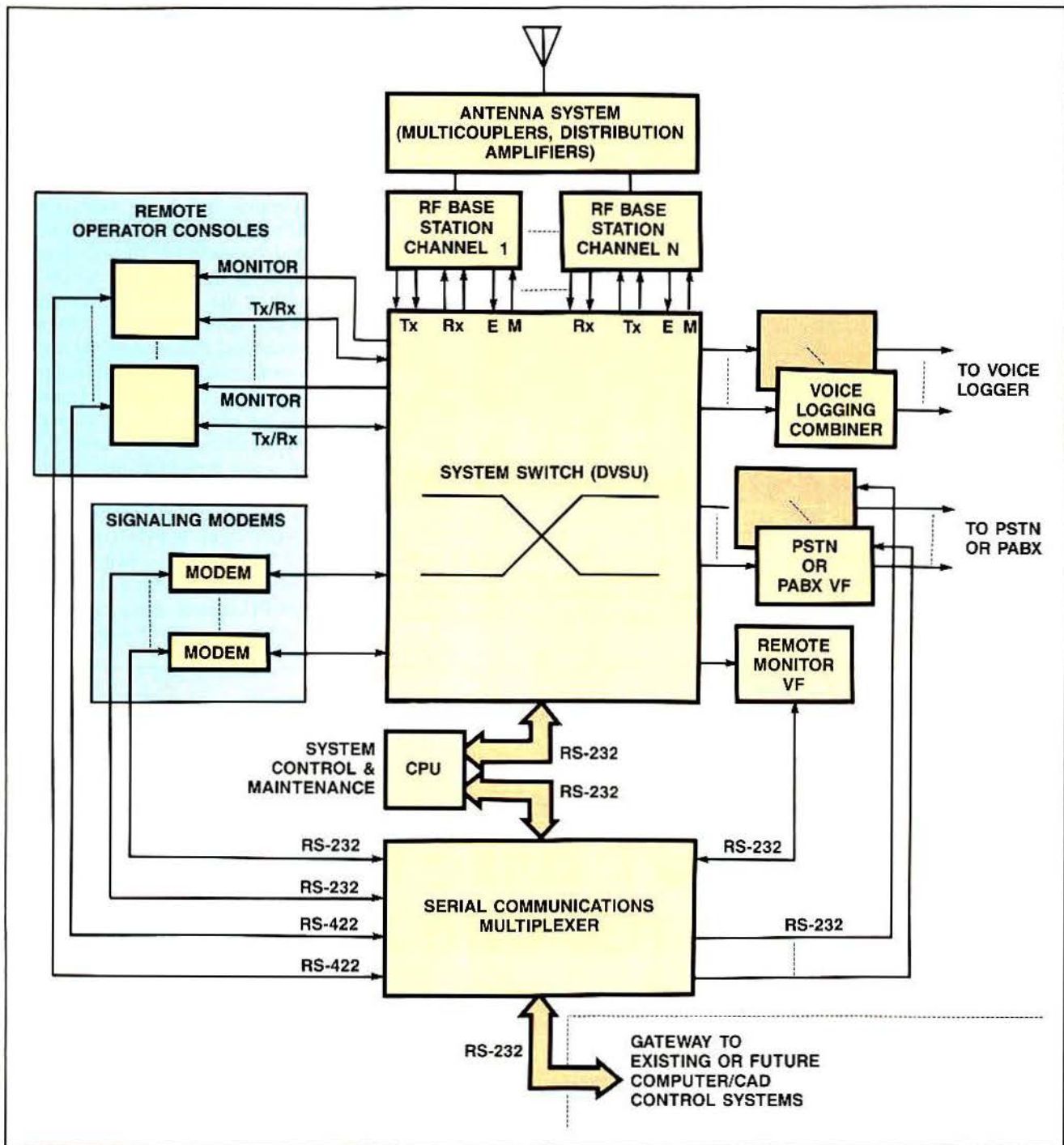


Figure 1. A block diagram of a multichannel, multioperator private mobile radio digitally controlled console system shows its principle elements.

cific application, the DCCS was conceived as a universal answer to all base control system requirements. First, a general base control system model was identified. Second, individual functions were analyzed and defined. Third, individual building blocks were designed and developed. The result is a DCCS

that is flexible, universal and expandable at any stage to provide additional capacity, new functions such as data communications, connection to new or existing computer-based management systems or a combination.

Figure 1 above shows the principle elements generally found in a multichan-

nel, multioperator private mobile radio DCCS.

► *Antenna and base radio system*—The DCCS is RF transparent. It works with all radio equipment, and it does not depend on a particular make or model of base stations. The DCCS typically connects at the four-wire level with E/M



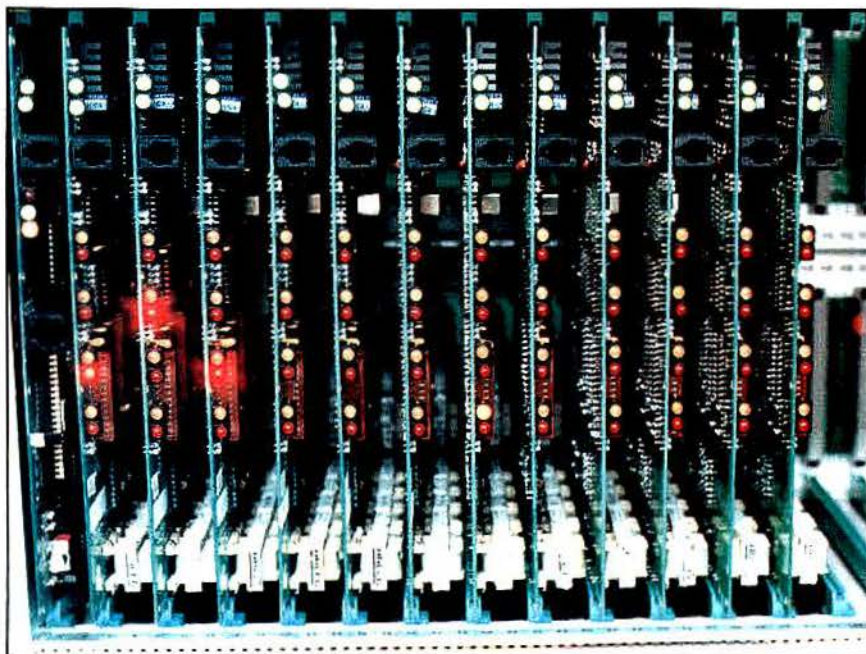


Photo 1. The digital voice switching unit, a stand-alone 19-inch rack module, contains a CPU card (first card from the left) and as many as 16 line cards per card cage. Twelve cards actually are fitted. Each line card provides four four-wire E/M ports. Cards are fitted with several single-point light-emitting diode (LED) indicators to visually indicate unit status.

signaling. (The E lead indicates a carrier is being received. The M lead controls the base station transmitter.) A four-wire connection is not essential. A two-wire connection is possible, but a four-wire connection enables facilities such as channel-patching and talk-through control.

► **Central switch**—A base control system's primary function is to connect any peripheral device, such as an operator console, data terminal, PSTN line and others, via any base station channel to any mobile user. The communication channel thus established may be of an analog nature (voice, for example) or may carry data information (selective calling and digital data, for example).

Voice band switching is handled by a digital voice switching unit (DVSU), which forms the central switch. (See Photo 1 to the left.) The DCCS central processing unit (CPU) controls the DVSU. The DVSU can switch any port to another port or combination of ports under CPU control. Input/output ports universally are four-wire plus E/M.

IMCE booth #404



## TAIT base stations— as reliable as gravity.

An apple started Newton's thoughts on gravity's reliability. TAIT believes that base stations and repeaters should deliver that same sort of reliability. Our two-year warranty reflects that belief. Do others measure up?

🍏 **Apples are equally easy to maintain**—just a polish now and then. TAIT modular radios, using industry-standard components, are no problem for any experienced tech.

🍏 **Apples are discrete**—no interference. TAIT adheres to the highest noise immunity standards in the industry; standards radios built *only* for the U.S. can't meet.

🍏 **Apples are compact**—with high value. Where other systems are refrigerator-size, we put a briefcase handle on TAIT repeaters. Call for more on:



**Radios reliable as  
gravity in 80 countries**

**1-800-222-1255**

**Fax: 713/468-6944**

© 1992 TAIT Electronics.

Circle (9) on Fast Fact Card



# Why Pay Z-Big Bucks for Tone Panels?



**At only \$299 our TP-154 has just  
blown Z-competition away!!**

**Everything is standard:**

- 50 CTCSS Tones • 104 DCS Codes
- Supports 154 subscribers
- Remotely DTMF programmable

The TP-154 is the only Shared Repeater Panel available that can simultaneously support 50 CTCSS and 104 DCS subscribers. A host of globally programmable and per subscriber features allows you to customize the repeater on a per user basis. The TP-154 can be locally or remotely programmed using DTMF Signalling. All user programmed variables can be downloaded (site to shop) to our CD-1 Communications Decoder for visual verification and validation.

The low price of the TP-154 also makes it attractive for small private systems and gives you the selection of any DCS or CTCSS code.

**CALL TOLL FREE: 1-800-545-1349**

• 60-day return privilege • One year warranty •



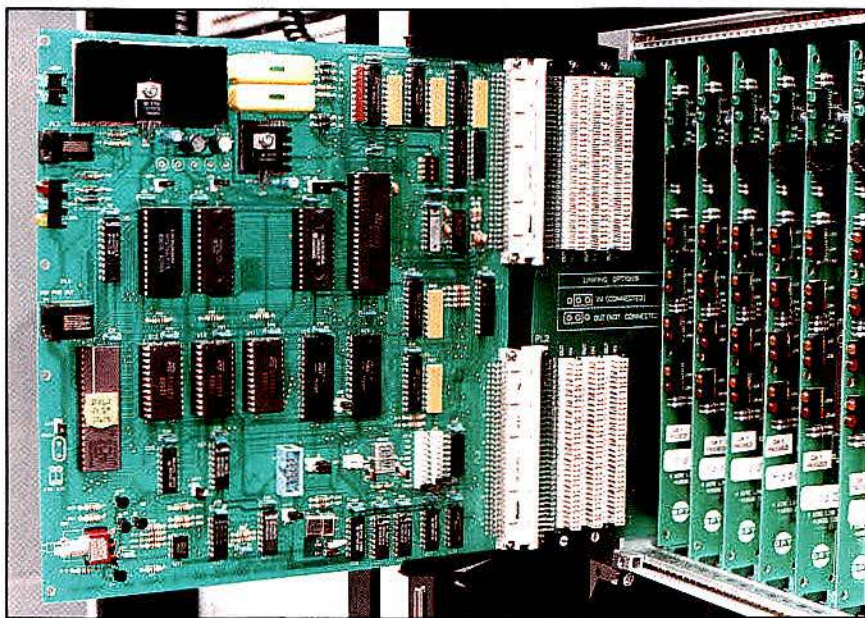
**CONNECT SYSTEMS INC.**

2064 Eastman Ave., #113 • Ventura, CA 93003 • Phone (805) 642-7184 • FAX (805) 642-7271

CSI is a registered trademark of Connect Systems Inc.

Circle (10) on Fast Fact Card





**Photo 2.** A serial communications multiplexer (SCM) card frame holds six 'slave cards' fitted inside the rack and the SCM controller card fitted on an extender module for service and checking purposes.

The DVSU uses digital switching. Each input/output port is fitted with a codec that converts voice-frequency sig-

nals into a 124kbps (kilobits per second) pulse-code modulation (PCM) format. The converted voice-frequency signals

are fed to the DVSU PCM bus.

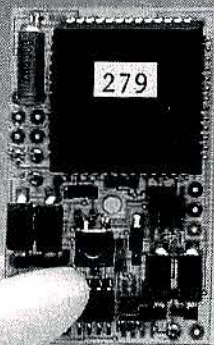
A DVSU consists of a controller card that provides switching control and external RS-232 input/output functions, and a series of plug-in line cards. Each line card provides four four-wire voice circuits, each with a standard E/M signaling interface.

The DVSU controller card manages as many as 64 line cards or 256 audio circuits. As many as four conference bridges may be installed. Each bridge supports a range of capabilities from one conference of 32 parties to 10 conferences totaling 32 channels.

Digital switching technology offers superior crosstalk and signal-to-noise performance. The signal-to-noise ratio and crosstalk isolation typically exceed 70dB. Distortion is negligible.

► *Digital system communication*—In a multiconsole, multiperipheral environment, digital communication between the various elements in actual practice is essential to build a successful system. Thus, all peripherals are controlled serially and operate under CPU control via

# Get the goods on them.



## Digital ANI

**Introducing CSC's ID-33 Encoder for Automatic Number Identification—** This state-of-the-art, subminiature ANI board will stop the horseplay and end the stuck mikes. It includes a time-out timer and emergency/status messages as well as ANI; transmits the ID in a mere 100 milliseconds. Fleet prices from \$69 to \$121. Call for brochure.

**CSC CONTROL SIGNAL CORPORATION**

1985 S. Depew St. #7 Denver, CO 80227 (303) 989-8000

**CALL TOLL FREE 1-800-521-2203**



# NO RELAMPING UNTIL 2012

...WHEN YOUR OBSTRUCTION RECEIVES OUR ADVANCED LIGHTING SYSTEM

## The Performer<sup>®</sup>

Light  
Bulb  
for Towers  
Guaranteed 20 Years

Product reliability and efficiency are crucial if your company is to be profitable.

**THE PERFORMER<sup>®</sup>**, a light bulb guaranteed for 20 years, is shedding new light on permanent solutions for your obstruction lighting needs.

Available in 600 watt or 85 watt, **THE PERFORMER** encompasses a half wave rectified diode to restrict electricity flow plus uses 85% Krypton gas to greatly improve filament life for brighter, longer lasting bulbs. This makes the 85 watt **PERFORMER** bulb brighter than any 116 watt bulb presently used. By reducing electrical demands by 31 watts per bulb, **THE PERFORMER** not only greatly reduces energy costs, but with a 20 year guarantee, offers huge savings in replacement and labor costs for your obstruction lighting. No other bulb can match **THE PERFORMER** for dependability and efficiency.

Call 804-784-2337 today and start seeing highly visible savings.

### WHY OUR LAMPS ARE GUARANTEED TO LAST 20 YEARS.

85% Krypton gas increases bulb brightness & greatly extends filament life.

Supported coiled coil filament resists shock and vibration.

Corrosion resistant brass base.

Advanced half wave rectified diode allows the bulb to burn cooler, making the filament last much longer.



Specialists in obstruction lighting  
INSTALLATION • SALES • SERVICE

#### U.S. DIVISION

##### GILCRIS CORP.

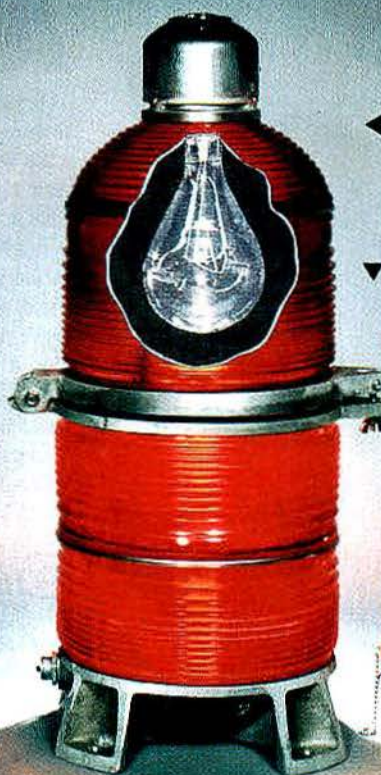
12505 Patterson Ave. • Richmond, VA 23233  
804-784-2337 • Fax: 804-784-0334

#### CANADIAN DIVISION

##### GILCRIS LIGHTING CORP.

3600 K. Boul. Matte  
Brossard (Quebec) J4Y 2Z2, MONTREAL  
514-444-5300 • Fax: 514-444-2304

Circle (12) on Fast Fact Card



◀ Beacon houses two 175,000 hour 600 watt **PERFORMER** PS-40 lamps for full 360° visibility.

▼ Double obstruction lights use two 175,000 hour 85 watt **PERFORMER** lamps.



## Principle elements

The principle elements found in a multichannel, multioperator private mobile radio digitally controlled console system (DCCS):

- ☐ Antenna and base radio system elements.
- ☐ Central switch (digital voice switching unit).
- ☐ Digital system communication.
- ☐ Serial communications multiplexer.
- ☐ Operator consoles.
- ☐ Selcal and signaling modems.
- ☐ PABX/PSTN interface.

serial duplex data links.

This approach has advantages. It makes the system highly flexible because changes and enhancements can be implemented with software instead of hardware. Consoles may be built from

conventional audio and control hardware. Alternatively, the operator interface can be implemented using computer terminals. New peripherals can be added any time, with only some additional CPU software being required in many cases. Finally, computer-controlled data and control systems may be connected to the DCCS directly using a serial communications multiplexer.

► *Serial communications multiplexer (SCM)*—It is not practical to connect serially controlled peripherals directly to a CPU. The number of computer serial ports usually is limited. Thus, a multiplexer is required.

The multiplexer must be intelligent because it must communicate with a variety of peripherals, each with specific communication protocols. In addition, it must store information in buffers for later interrogation and transfer to the CPU because the CPU operates on a time-sharing basis: The CPU is not available to any particular peripheral at any time.

The DCCS SCM is composed of a dedicated, processor-controlled CPU card that communicates with the system CPU via a high-speed data link. Also part of the multiplexer are the dedicated CPU card's associated SCM "slave cards," with which it communicates via a parallel high-speed data bus. Each slave card provides four serial ports. Each serial port can have its own unique communication protocol. Additional system capacity is obtained by plugging in more SCM cards. Slave cards are fitted either with an RS-232 interface or with an RS-422 interface to facilitate connecting peripherals via extended cable lengths. (See Photo 2 on page 14.)

Physically, the RS-232 and RS-422 slave cards are nearly identical. They use the same printed circuit board and overall electronic components.

► *Operator consoles*—The operator's audio facilities include a built-in speaker and telephone-type handset. A headset and boom-type microphone-and-PTT switch may be connected, too. An independent audio output channel pro-

# DON'T TRY THIS WITHOUT A PORTAGRIP®.

If you turn an ordinary portable two-way radio holder over and give it a shake, chances are the radio will pop out. But with a PortaGrip from PanaVise, the radio stays firmly in place. This means that when you install a PortaGrip in your vehicle, your hand-held two-way radio will be right where you want it. You won't lose it during a quick stop or a sharp turn!

The PortaGrip attaches to any AMPS-compatible cellular phone mount and has independently adjustable jaws for a custom fit (holds radios 1.6 to 2.6" wide), "sure-grip" soft jaw pads that won't scratch your radio, and easy "one-hand" operation. Plus, it's competitively priced, available with or without a Slimline phone mount, and includes complete installation instructions.

So go ahead — try this test at home. But don't try it without a PortaGrip! For more information, contact PanaVise or your local representative.

## PANAVISE®

PANAVISE PRODUCTS, INC.

1485 Southern Way, Sparks, NV 89431

Phone: (702) 353-2900 Fax: (702) 353-2929

Radio not included. PortaGrip (Model #701) sold separately or with a Slimline car phone mount. PortaGrip is made in the USA and is a registered trademark of PanaVise Products, Inc. Patent Pending. ©1992 by PanaVise Products, Inc.



Circle (13) on Fast Fact Card



# *It's about time...*



*Specifications:*

**LANMARC™ EASY-LINK:**

- Provides AVL using GPS for accurate position determination.
- Suited for smaller fleets of 10-50 vehicles.
- Operates as stand-alone or integrated with CAD.
- Plug-compatible installation.

**LANMARC™-5000:**

- Provides AVL using GPS for accurate position determination.
- Combination radio data modem and five-channel GPS receiver in one easy-to-install package.
- Designed for larger fleets requiring CAD integration.

*It's about time someone made an affordable, flexible vehicle tracking solution using GPS.*

*Coded Communications combines a radio data modem with an Automatic Vehicle Location (AVL) package to offer a system that fits any fleet operator, from large police or utility fleets to small courier or towing companies. Our new LANMARC® EASY-LINK and LANMARC®-5000 (shown below) can integrate with existing or*



*future CAD and mobile data systems. Knowing exactly where your fleet is*

*at all times improves response time, safety, efficiency and profits. At Coded, we understand that timing is everything.*

2375 Camino Vida Roble  
Carlsbad, CA 92009  
(800) 228-6367  
(619) 431-0077 Local  
(619) 431-1372 Fax

**Coded** Communications  
*Keeping data on the move*



vides monitoring of non-selected (non-operational) voice channels via an external speaker. (See Photo 3 to the right.)

A two-line-by-20-character liquid crystal display and a series of pushbuttons on a 3x4-button keyboard provide the operator interface.

The consoles are controlled serially, to the RS-232 standard, to allow the use of extended cables. The console software essentially is fixed because the actual console operation is set and configured in the CPU.

Consoles are fitted with an RS-232 port that may be connected to an optional screen-based terminal to provide extended display facilities if required.

For special applications, the console's RS-232 port may be connected to a personal computer to provide computer-based access to the system.

► *Central processing unit*—The CPU is a standard IBM-compatible AT PC fitted with two serial ports. One port connects to the serial communications multiplexer via a high-speed serial bus

(normally 19.2kbps). The other port connects to the digital voice switching unit serial control port.



Photo 3. The DCCS console with handset has three rows of push-buttons under the display for channel and PABX line selection. The 3x4 keyboard dials the telephone and selective calling.

A keyboard and screen may be connected for system maintenance. They are not required for normal operation. (See Photo 4 to the right.)

Because it is modular, the CPU software allows quick and effective system customizing and configuring.

An optional system printer may be connected to further facilitate system maintenance.

► *Selcal and signaling modems*—To provide selective calling (selcal) or data facilities, signaling modems may be added to the system upon initial installation or later when the system is expanded and signal facilities may be required.

One such modem, a tone sequential selcal encoder-decoder, uses digital analysis to improve the signal-to-noise ratio, to reduce falsing to a minimum and to increase resistance to interference and distortion.<sup>1</sup> Digital decoding allows tone sequences as short as 20ms (milliseconds), resulting in a typical message time of 100ms for selcal sequence.

# Our new broadband panel of experts.

They're experts at versatility. Experts at reducing interference. They cover such a wide range, it takes fewer of them to accomplish just as much.

Perfect for any application: SMR, Cellular, Paging, even PCN, Celwave's new broadband line of panel antennas are available in 60°, 80°, 90°, 105° and 120° sector versions. Their profiles are slim, they're aesthetically pleasing, strip line fed, have no soldered joints and are made of irridited aluminum. Radiating elements

and feed point are protected from the weather by an environment-proof, ABS Radome.

When it comes to improving your system's performance, don't trust anyone but a Celwave expert.

**CELWAVE** 

DIVISION OF RADIO FREQUENCY SYSTEMS

Celwave, Route 79, Marlboro, NJ 07746

(908) 462-1880 (800) 321-4700





Photo 4. The DCCS video screen displays status and current configuration data. It has no operational function, being used only for system installation and maintenance.

The selcal modem can operate on a range of international tone sets, including CCIR, EEA, EIA and ZVEI stan-

dards. It handles tone periods from 20ms to 100ms. It is programmable to operate on any of the commonly used

sequence formats, including five-tone, five-tone/status and six-tone formats.

Finally, the modem has a non-predictive decoder that decodes any selcal number received, provided the sequence includes the correct tone set, period and format. It performs all front-end processing and reports correct decodes in RS-232 format to the CPU via a serial communications multiplexer slave port.

The modem transmits any new selcal messages as directed by the CPU. On-board buffering prevents new selcal encode commands from the CPU from aborting decodes in progress. Similarly, decoded sequences are buffered and reported to the CPU on command.

In turn, the CPU passes received selcal messages to the consoles for display, with other selcal processing data such as queueing, alarm response and status. The console operator may key in selcal sequences with the 3x4 keypad.

When digital data modems are used instead of selcal modems, the serial communications multiplexer may be

# CELWAVE

DIVISION OF RADIO FREQUENCY SYSTEMS





# WHEN IT COMES TO DTMF... NOBODY DOES IT BETTER!

## **MODEL NC401**

### **MICRO-MINIATURE DTMF DECODER**

Three Decoders in one unit offering multiple user configurable output functions through microcontroller technology.

## **MODEL NC421**

### **MULTI-FUNCTION DTMF DECODER**

Enclosed in smartly styled plastic case with illuminated membrane control panel for mobiles.

## **MODEL NC4000**

### **MULTI-FUNCTION DTMF DECODER**

For control of remote applications, available with enclosure or 56 pin edge connector and a variety of options.

## **MODEL NC4004**

### **MULTI-FUNCTION DTMF REPEATER**

Capable of controlling 10 outputs while sensing 10 external inputs.

## **MODEL NC404**

### **SUB-MINIATURE DTMF ENCODER**

Digitally synthesized tone generator.

## **MODEL NC409**

### **MICRO-MINIATURE DTMF ANI ENCODER**

Exclusive Alarm and Man-Down features plus Transmit time-out timer, busy channel lock-out and microphone mute are only a few of the many features available in this microcontrolled unit.

## **MODEL NC410**

### **NEW...DTMF ANI ENCODER DESIGNED WITH THE RCC IN MIND!**

Simplifies telephone interconnects.

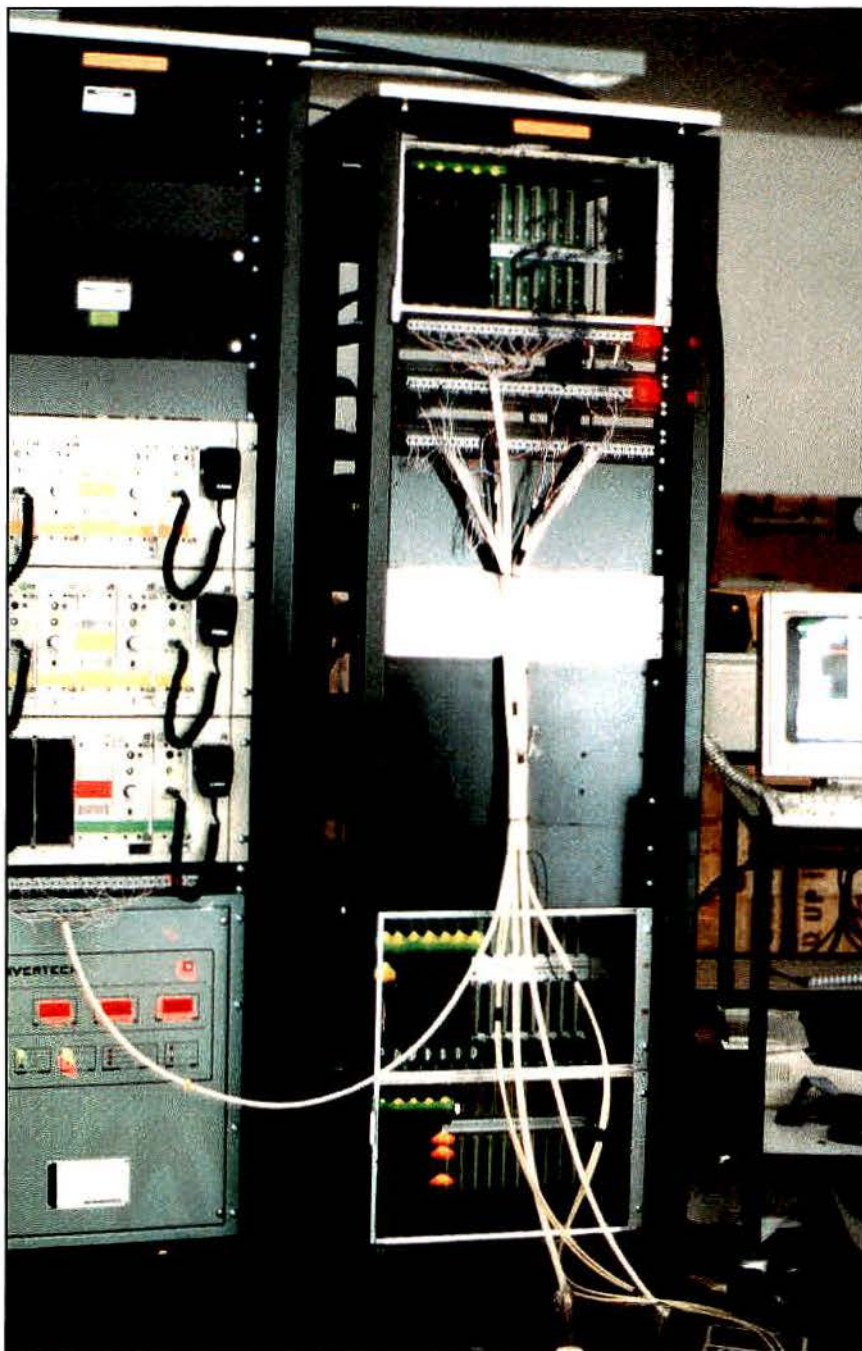
15 memory locations, last number redial, automatic connect/disconnect sequences and programmable "transmit refresh" provide easy operation in any mobile application.

**Call 1-800-874-8663  
for complete information  
and pricing.**



12438 Loma Rica Dr., Grass Valley, CA 95945

Circle (16) on Fast Fact Card



**Photo 5.** A typical digitally controlled console system undergoes final testing at the Springvale, Victoria, factory. External cabling is temporary and is for factory testing only. The system provides for four operator consoles, multiple radio channels, selective calling, PABX/PSTN interconnection and remote monitoring. A voice logging recorder is installed, too. The rack on the left includes the radio equipment, such as links, multicouplers and the dc power supply.

connected directly to an existing database or computer-aided dispatch system via an SCM gateway port to extend the system with full digital signaling facilities.

The DCCS can be fitted with optional PABX/PSTN access via a standard

telephone interface peripheral device. This device handles line loop, ring detect and dial out functions. Its audio ports connect to the DVSU. Its serial control port connects to the CPU via an SCM slave port.

Console operators can set up calls into



# cushcraft/Signals

## ANTENNAS WITH THE BEST CONNECTIONS

**ULTRALINK™**  
**C A B L E**

### THE ORIGINAL ALL BRASS MOUNT

Since 1978, Cushcraft/Signals all-brass mount has been the industry standard.

- Non-corroding
- Excellent conductor to ground
- Parts will not seize together
- Easily removed
- Large improved grounding teeth
- Soldered ground lug

### UltraLink CABLE

Solves many problems experienced by mobile installers.



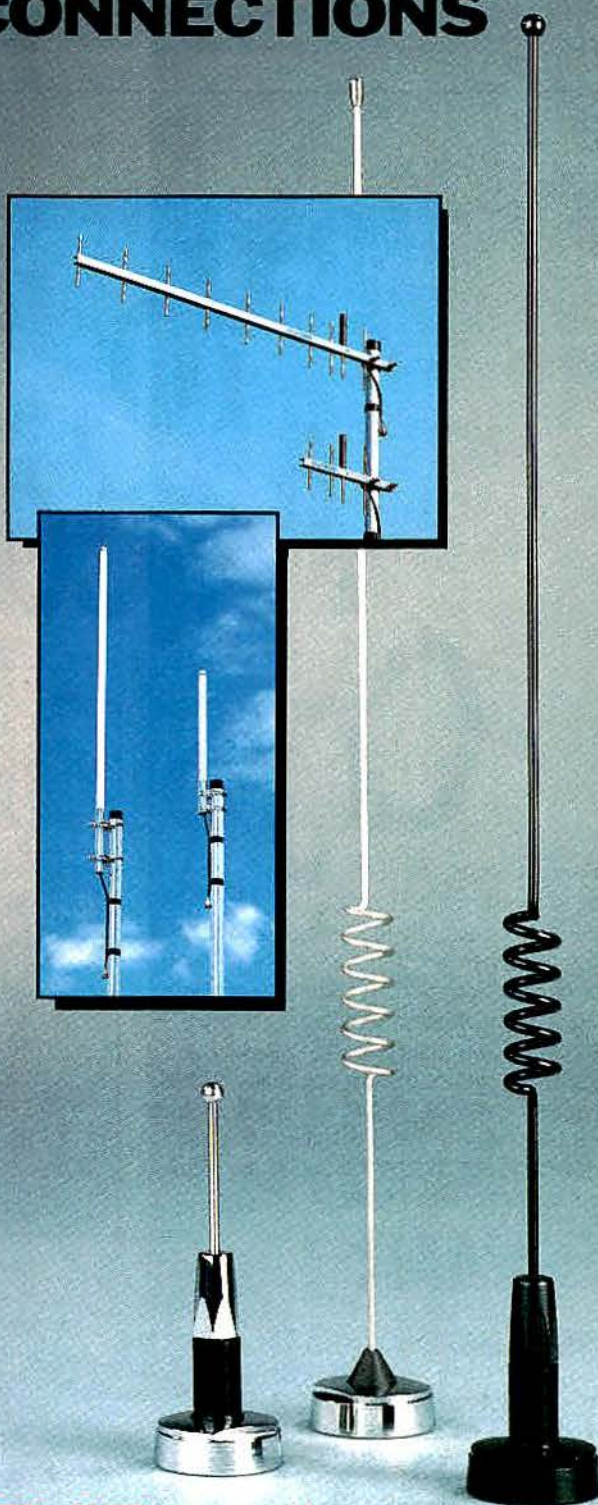
- Low-loss Teflon® dielectric
- Withstands high temperature
- Fits standard RG58 size connectors
- Easily removed dual shields
- Used in our base and mobile antennas



**New  
Catalog**

Cushcraft/Signals supplies a complete line of base and mobile antennas. Call us or your favorite distributor for fast delivery or our latest catalog.

**1-800-258-3860 • FAX: 1-800-258-3868**



# cushcraft/Signals



the PABX or PSTN networks. When the console operator has PABX as one of the monitored channels, an incoming telephone call is reported to that console, alerting the operator that a call is waiting.

Console operators may connect incoming or outgoing calls manually to a mobile extension by using the patch facility. Alternatively, mobile phone calls

may be automatically placed and received, using CPU software and associated signaling modems to encode and decode mobile and remote subscriber identities.

#### Other peripherals

Several other standard peripherals are available to improve DCCS operation.

A voice logging combiner combines

each 2x2 wire audio port into a single two-wire signal for logging by a recorder. Each combiner card has a capacity of four four-wire circuits.

A supervisory remote monitoring system may be overlaid on the whole radio system to report remote site status conditions, such as VSWR and RF PA output power.


The system's base decoder input connects to the DVSU. The decoder's serial data port connects to the CPU, which in turn directs supervisory messages and alarms to the consoles for display and operator response.

Other peripherals may be added to the system. The only compatibility requirement is the presence of standard 600Ω voice-frequency input/output ports and the availability of a suitable serial control port. Photo 5 on page 20 shows a typical implementation of a DCCS.

#### Conclusion

The DCCS base control system adheres to a basic philosophy of standard voice-frequency and data interface for its components to boost technical performance and allow the addition of new, existing, standard or proprietary peripherals.

The mechanical implementation is based on the same principle, using standard 19-inch rack and Eurocard technology with cards plugging into standard motherboards to provide future expansion capacity.

These hardware elements, together with software technology, result in a systems technology that is flexible, economical and compatible with future enhancements and expansion. 

#### References

1. Van Enk, Frits P., "Five-Tone Sequential Boosts System Capabilities," *Mobile Radio Technology*, October 1988.
2. Van Enk, Frits P., "Minimum Requirements For CTCSS Signaling," *Mobile Radio Technology*, November 1987.

Although these back issues may be available at a library, they are unavailable from the publisher. Back issues of the last two years may be purchased from Intertec Publishing for \$5 each, postpaid. To order by telephone, call 913-967-1711. Mail orders go to Circulation Services, Intertec Publishing, P.O. Box 12901, Overland Park, KS 66282.

# Yo, Aged Crystals.

Bomar Crystals are 100% aged to exact specifications for totally clean, drift-free reception. Even 48-hour emergency crystals are precisely aged, or Quality Control won't ship them to you. Aging stops crystals from drifting. Adds stability which maintains the frequency you specified—not for months but years. Bomar's high-performance crystals won't drift .001 per cent in one year. We guarantee it. We also guarantee our crystals will outlive the life of the radio. Yo, check it out.

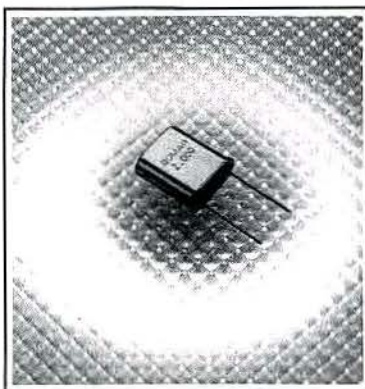
## BOMAR

201 Blackford Avenue  
Middlesex, N.J. 08846

TOLL FREE FAX:  
1-800-777-2197

CALL TOLL FREE  
**1-800-526-3935**

Circle (18) on Fast Fact Card





# The New STABILOCK® 4015 Radio Test Set Tests Great—Less Weight

Under  
\$13K/3 Year  
Warranty

Finally, a two-way radio tester that fits under a helicopter seat, weighs less than 20 lbs., provides all the capabilities you've dreamed of in one unit, and doesn't cost an arm and a leg.

The STABILOCK 4015 packs a lot of features in a compact design:

- ☐ spectrum analyzer with audio
- ☐ electroluminescent display for easy viewing night or day
- ☐ licensed CLEAR CHANNEL LTR® testing capability
- ☐ memory cards to load and run tests automatically, including all cellular formats
- ☐ digital storage oscilloscope
- ☐ internal battery

Lighten your two-way test load today—call for more information on the STABILOCK 4015:

1-800-225-5765 (in MA: 508-671-9700).

CLEAR CHANNEL LTR is a registered trademark of the EF Johnson Company. STABILOCK 4015 is a registered trademark of Schlumberger Technologies.

## NEW OPTION



Ericsson GE Mobile Communications Inc.  
Mountain View Road • Lynchburg, Virginia 24502

**EDACS™**  
Trunking Licensee

## Quality Test Solutions Schlumberger Technologies

Schlumberger Instruments  
P.O. Box 7004  
829 Middlesex Turnpike  
Billerica, MA 01821, USA  
Phone-508-671-9700  
Fax-508-671-9704  
1-800-225-5765 (outside MA)



**Schlumberger Technologies**

Canadian Representative  
Atelco Limited  
9225 Leslie St. Unit 7  
Richmond Hill, Ontario  
L4B 3H6  
Phone: 416-882-9455  
Fax: 416-882-9454

Schlumberger Instruments  
Victoria Road  
Farnborough, Hampshire  
GU14 7PW, England  
Phone-44 252 544433  
Fax-44 252 543854  
Telex-858245

Schlumberger Instruments  
50 Avenue Jean Jaurès  
BP 620-06  
F-92542 Montrouge Cedex, France  
Phone-33 1 47 466700  
Fax-33 1 47 466727  
Telex-631468 ENERINS

Schlumberger Technologies GmbH  
Ingolstädter Str. 67a  
D-8000 München 46  
West Germany  
Phone-49 89 31889-0  
Fax-49 89 31889-160  
Telex-5215015 SMG D.

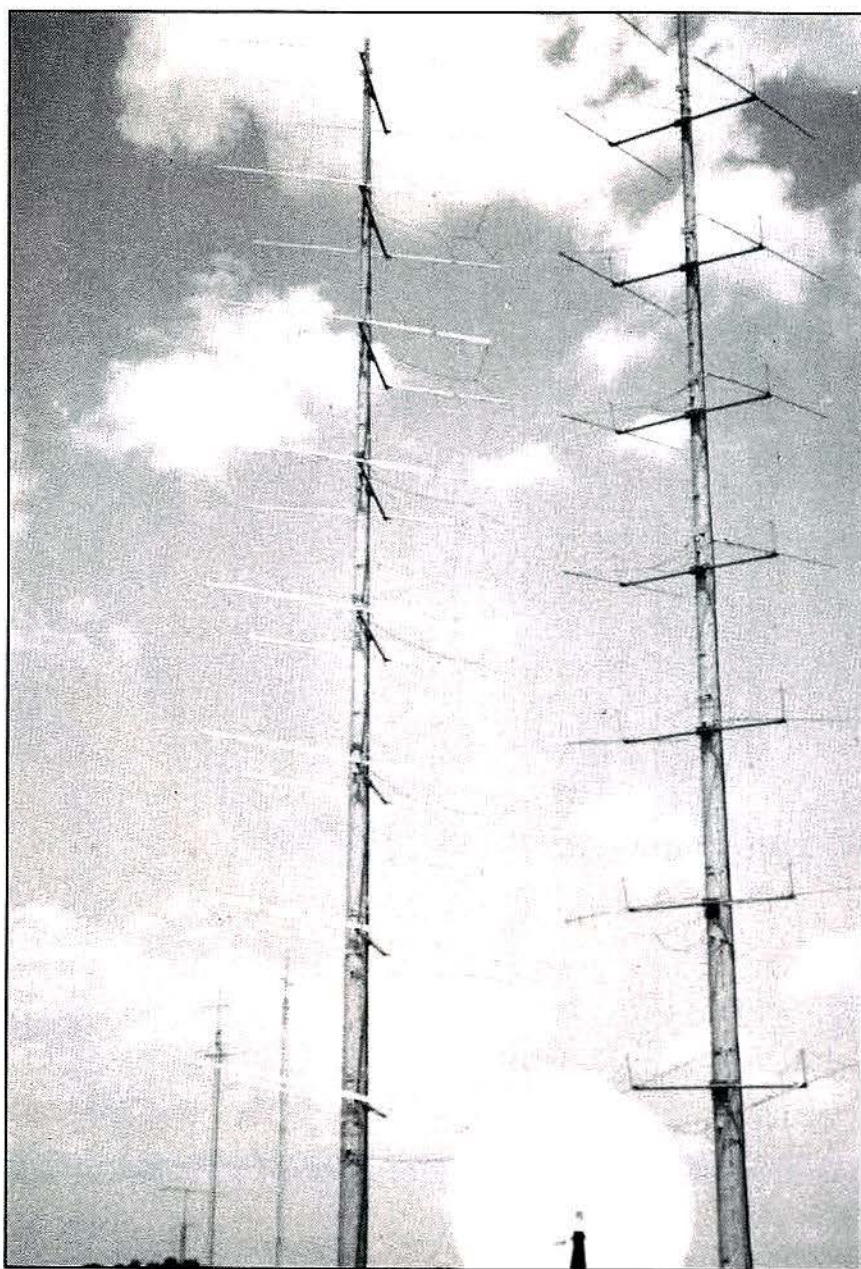
Circle (19) on Fast Fact Card



---

# Static discharger wicks cut precipitation static noise

*Adapted from aircraft applications, static discharger wicks for towers and antennas are designed to reduce radio noise caused by corona discharge and precipitation static. Improvements as great as 40dB have been noted.*



---

**By Michael E. Norton**

---

Have you ever wondered why a receiver's noise floor elevates above the ambient noise level and, more importantly, what can be done to reduce or eliminate the problem?

Modern receivers have high sensitivity and extend radio communications range under normal conditions. But electrostatic discharge (ESD) produces broadband noise that can degrade system performance by raising the noise floor.

In 1988, I began monitoring radio signals used for nationwide communications via meteor-burst propagation. The signals are slightly stronger than galactic noise. Daily monitoring revealed the true importance of noise. Noise level increases of only a few decibels can entirely mask weak signals. As noise increases, a high receiver signal-to-noise ratio can be swamped easily.

Noise "crashes" propagated from distant thunderstorms and noise from man-made electromagnetic interference must be tolerated. At least they usually come in the form of impulses. Such noise may be bothersome, but at least it is not normally sustained.

ESD noise, on the other hand, may continue for long periods.

## **Earth-ionosphere capacitor**

Air, a mixture of gases, largely is composed of nitrogen and oxygen. Air

---

Norton is the owner of Static Busters, Elizabethtown, KY, 502-737-5082. He is a senior member of the Association of Communications Technicians, and he holds a NABER technician certificate.

---



# And you thought you could only get "Aliasing" on a C.A.D.

*Introducing advanced two-way ANI products from Cimarron Technologies.*

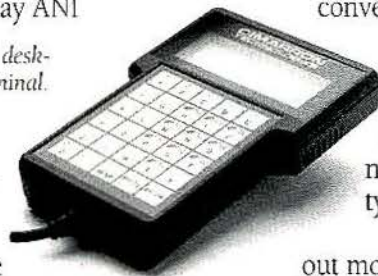


*C-Mark III ace full-featured two-way dispatch display, with Aliasing.*

The advanced family of two-way ANI products from Cimarron Technologies gives you the functionality of expensive computer aided dispatch systems in a compact, economical package.

*CDT-1 desk-top terminal.*

Plus, our new subminiature CDEU-1 encoder-decoder gives virtually any portable or mobile radio two-way communications capability. It features "TKO" remote radio disable, message acknowledgement, selective call and remote monitoring and control. And the CPF-1 hand-held programmer allows you to

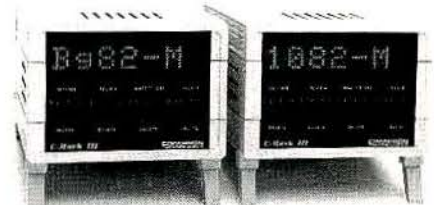


conveniently program more than 34 options right in the field.

In the dispatch center, our C-Mark III series of two-way dispatch displays instantly convert numeric data fields and IDs to alpha numerics. Up until now, you could only get this type of aliasing with expensive C.A.D. units.

To find

out more about our economical, two-way ANI system, contact Jack Batchie, National Sales Manager, at Cimarron Technologies. Call toll-free 1-800-487-7184 in the USA and California, or (619) 738-3280.



*The C-Mark III Series of two-way dispatch displays give you the functionality of expensive C.A.D. systems.*

## **CIMARRON TECHNOLOGIES**

*CDEU-1 encoder-decoder features two-way handshaking protocol that guarantees message reliability.*



generally is considered to be an insulator. It would be an excellent insulator if all its oxygen and nitrogen molecules were in a neutral state. But air is composed of varying quantities of neutral molecules and positive and negative ions—charged molecules.

As the number of ions in the air increases, air becomes a progressively better conductor. Generally, the higher the altitude, the more ions air contains. At an altitude of 40 miles to 50 miles, in a layer of the atmosphere called the ionosphere, ions are so plentiful they refract radio waves.

Although the ionosphere is electrically conductive, as a whole it is considered to be "uncharged" because the layer's number of positive ions equals the number of negative ions and electrons. The ions and electrons are distributed within the ionosphere in layers of various altitudes and degrees of charge.

In contrast, the earth has surplus electrons. Its charge approximates 300,000V to 400,000V negative compared to the ionosphere.<sup>1</sup> This potential difference,

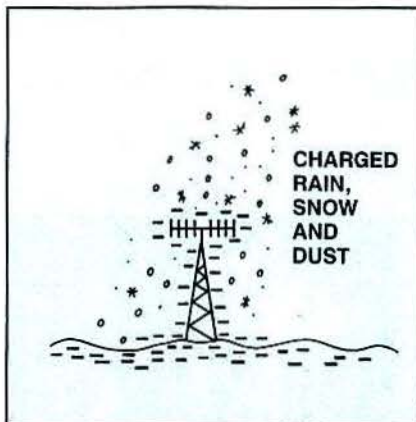
together with the atmosphere's total conductive qualities, is sufficient to cause the earth to lose electrons to the ionosphere continually.

The entire earth's surface and the ionosphere may be considered to be oppositely

charged plates of a vast capacitor with a leaky air dielectric. Along with ions that make the air slightly conductive, meteorological processes contribute to the earth-ionosphere "capacitor's" leakage. The hydrologic cycle—precipitation—falling rain, for example—tends to drop larger, less mobile ions toward the earth as electrons rise in moisture-laden updrafts.

The earth's steady loss of electrons is called *ionic current*. Infinitesimal as it is, it has been measured and it amounts to about 9 $\mu$ A for every square mile on the earth's surface.<sup>1</sup> Ionic current flows via the most convenient conductive path—the path of least resistance. Thus, most of the electrons are discharged at natural and man-made *points*, such as peaks, trees, buildings, towers and antennas that project into the air.

When electrically charged particles, such as raindrops, snow and dust, strike an antenna's tower, boom or elements, they induce a current impulse that produces broadband noise. (See Figure 1 to the left.) The noise is called *precipitation static*. It generally is defined to include all external atmospheric electrical effects that produce electromagnetic interference.



**Figure 1.** Electrically charged particles, such as raindrops, snow and dust, strike an antenna's tower, boom or elements and induce a current impulse that produces broadband noise. The noise is called *precipitation static*.

## Get Control.



### Remote Control, of up to 16 Channels. Radius M200 or Maxtrac 300 Series Radios.

The CPI model MCR10 remote and MCR10P interface panel will allow you to remote control Radius or Maxtrac radios, up to sixteen channels, over any two wire voice grade circuit.

The MCR10 remote control system provides LED displays for remote channel indication, channel up and down buttons, PTT indicator, on-hook PTT capability, monitor button and indicator, intercom capability between parallel remotes and the radio, scan control button and indicator for those radios so equipped and speaker volume control.

#### Features

- Simple installation - No soldering, cutting or crimping.
- Provides remote channel indication.
- Does not require B308 option.
- Remote transmissions heard over radio speaker.
- Radio transmissions monitored on remote speaker.
- Uses any two wire voice grade circuit.

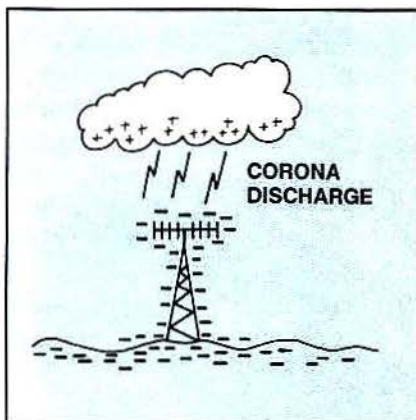


1186 Commerce Drive • Richardson, TX 75081  
(214) 437-5320 • FAX (214) 437-5360 • (800) 869-9128

Circle (21) on Fast Fact Card

#### Corona discharge noise

Another type of noise, *corona discharge noise*, happens when electrons flow through the antenna's tower, boom or elements and into the atmosphere when a charged cloud is near. (See Figure 2 below.)



**Figure 2.** Another type of noise, *corona discharge noise*, happens when electrons flow through the antenna's tower, boom or elements and into the atmosphere when a charged cloud is near.



# Follow the Leader

ANTENNA CATALOG

**MAXRAD**  
State of the Art Antennas

Home Office  
2495 Pan Am Blvd  
Elk Grove, IL 60007  
USA  
Order: (800) 323-9122  
Voice: (708) 595-3933  
Fax: (708) 595-3951

MAXRAD Europe  
3 Paddockwood House  
Lightwater Surrey GU18 5YT  
United Kingdom  
Voice: 44(0)-276-453137  
Fax: 44(0)-276-856114

Circle (22) on Fast Fact Card

**JANUARY 1993**

MAXRAD Inc. • 4350 Chandler Drive • Hanover Park, IL 60103  
Order: (800) 323-9122 Voice: (708) 595-3933 FAX: (708) 595-3951



Corona or brush discharge occurs when a charge builds up and electrostatic lines of force develop. More lines of force per square inch appear at the sharpest points where it is more likely a strong field will pull free electrons from the point.

Electrons pulled from a sharp point form a corona or brush discharge that causes radio noise.

This type of noise can be caused when a mobile antenna is in motion. To reduce the noise, most mobile antennas are fitted with a ball at the tip. (The ball offers protection against puncture wounds, too.) Because the mobile whip lacks a sharp point, corona discharge is reduced.

If enough electrons leave the tip, they heat and ionize air near the tip. The air

takes the form of a visible spark, known as St. Elmo's fire.

Corona is a major source of noise in the discharge category, but there are others, such as streamer currents that may precede lightning strikes and electrical arcs between objects with high voltage differences. When a charge builds up on an antenna, tower or other supporting structure, an arc may occur. The arc may leap between any insulated parts or poorly connected parts if the charge potential rises high enough—and it happens frequently.

### Hardware noise

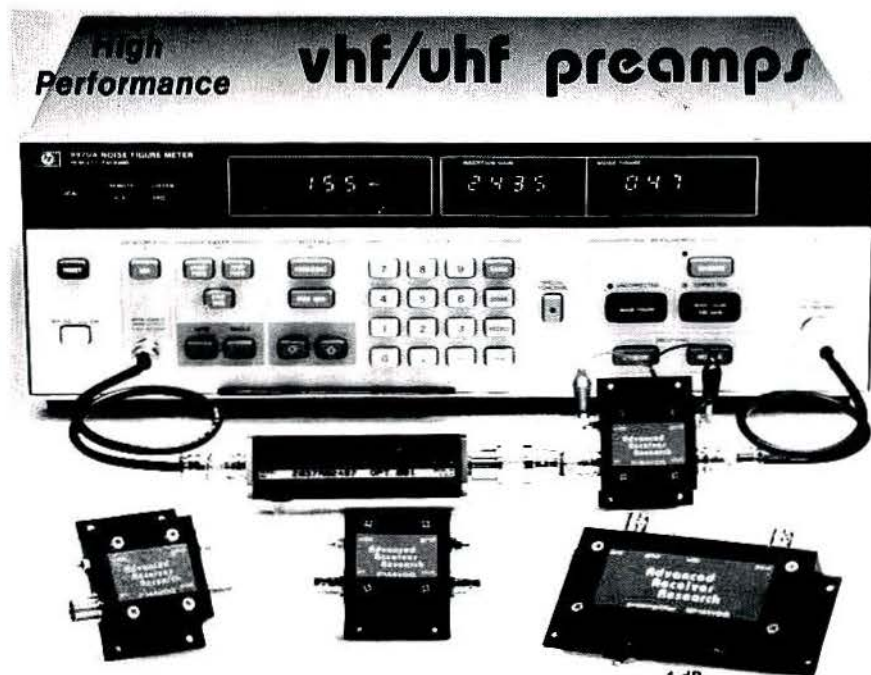
Another noise source is the antenna and tower hardware. Without proper grounding and bonding, the hardware may create multiple noise sources. Pay particular attention to any point where two conductors are in poor contact. Two conductors rubbing against each other can cause several types of noise, including rectification of strong radio signals from any nearby source.

If a feedline is not secured at short intervals, wind may cause enough movement to wear through the cable jacket, exposing the shield to intermittent contact with the tower and creating another noise source.

Joints formed of dissimilar metals, such as copper wire-to-galvanized steel tower connections for grounding, may corrode and oxidize quickly because of galvanic action. The best way to bond such joints is with exothermic welding, known by the trademark Cadweld.<sup>2</sup> Exothermic welding provides a mechanically rigid, electrically superior, low-maintenance connection that does not corrode or loosen.

Both corona and precipitation static, are well known and easy to recognize. (The abbreviation p-static often is used to refer to either or both.) P-static can raise the actual noise level 40dB to 50dB above the ambient noise level for sustained periods. The phenomenon long has been known to affect the HF radio spectrum, and it was not believed to have much effect above 50MHz. Recent, well documented reports indicate that sustained VHF and UHF p-static noise can and does occur.<sup>4</sup>

On HF, the elevated noise floor is readily apparent because of the nature of single-sideband (SSB) signals and the action in which rising background noise



Receive only	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	Comp. (dBm)	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$119.95
<b>Inline (rf switched)</b>						
SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	\$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	\$139.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP6970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. System S/N Improvement 6-14 dB typical. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include \$2 shipping in U.S. and Canada. C.O.D. orders add \$2. Air mail to foreign countries add 10%. Order your ARR RX only or inline preamplifier today and start hearing like never before!

**Advanced  
Receiver  
Research**

Box 1242 • Burlington, CT 06013 • 203 582-9409



Circle (23) on Fast Fact Card



# DECIBEL

**Tough MTD™ Fiberglass Antennas!**

**Dedicated to the Fine Art of Radiation Management!**

They're rapidly becoming best sellers! Decibel's Minimum-Tip-Deflection™ fiberglass antennas in Horizon Blue™ color handle tough environments, stiff winds, ice and snow! Choose the heavy duty, ruggedized 3" (76 mm) OD models or, for less stringent requirements, Decibel's new 2 and 1.5 inch (51 and 38 mm) OD fiberglass radomes. 406-512 and 806-960 MHz. Electrical tilt. Duals and triples. Up to 12 dB gain and 1000 watts input. Use Decibel's toll-free HOTLINE to FAX us your requirements.

**1-800-229-4706**

a member of the ALLEN TELECOM GROUP



**DECIBEL PRODUCTS**

P.O. Box 569610 • Dallas TX 75356-9610 • Order Hotline 1-800-676-5342 or FAX 1-800-229-4076 • Phone (214) 631-0310 • FAX (214) 631-4706

\*Warehouses that are qualified and certified to stock and tune certain filter products.

Factory Authorized Warehouses: Antenna Farm, Overland Park KS; Cartwright Communications\*, Cincinnati OH; Communications Associates, Joliet IL; Communications Express, Clifton NJ; Communications Works\*, Denver CO; M. Hutton\*, Dallas TX; Norcross GA; Marketronics\*, Sunrise FL; Primus Electronics, Joliet IL; Talley Electronics\*, Hayward CA; Santa Fe Springs CA; San Diego CA; Phoenix AZ; Tesso\*, Hunt Valley MD; Sparks NV. In Canada, ECD, Calgary, Alberta, Niagara-on-the-Lake, Ontario; Iaval, Quebec.

Circle (24) on Reader Service Card



masks weak signals. This reduces the receiver's signal-to-noise ratio, preventing otherwise usable reception.

Because FM is the most popular mode on VHF and UHF, the effects of p-static noise in those bands is not as readily apparent when it happens. Receiver desensitization as great as 20dB to 30dB may occur without unquenching the receiver. The noise decreases system range, makes received signals noisy and causes calls to be missed. The deficiency may be attributed to "poor conditions."

Sometimes the noise rises high enough to unquench the receiver. When it does, a repeater may transmit white noise "for no apparent reason."

P-static's frequency spectrum may lead to the conclusion that a given receiver range is immune to the noise. But frequency discrimination applies only to linear circuitry. Large transients that drive a receiver into non-linear operation represent another desensitization mechanism.

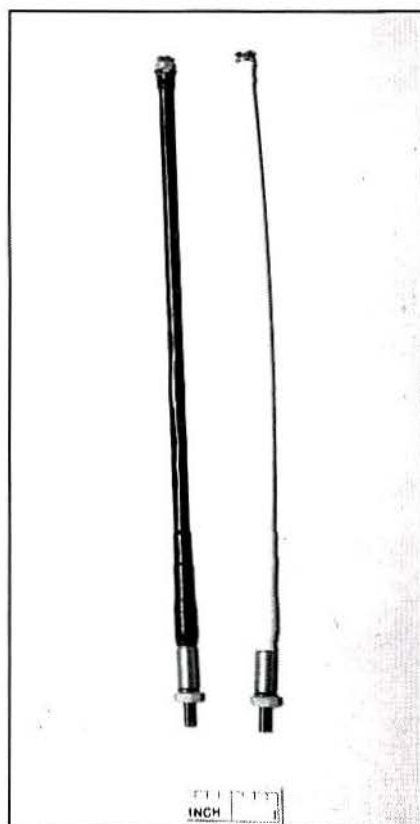
Typical characteristics of individual

electron avalanches that make up a corona discharge include an amplitude of 10mA, a rise time of 10 nsec (nanoseconds, which are one-billionth of a second) and a decay time of 100 nsec.<sup>5</sup>

For a typical 50Ω antenna, this characteristic results in an impulse voltage that peaks at 0.5V. Compared to normal receiver sensitivities in the range of 0.5μV, a 0.5V signal is huge.

The electron avalanche causes the broadband noise, which in turn is modulated at the avalanche repetition rate. The repetition rate ranges from a low audio signal of a few pops per second, through the audio range and up to at least 1MHz. Through the receiver, you hear a high-pitched, screaming noise that comes in cycles two to 20 minutes long.

The pitch changes constantly. At times, it sounds like ignition or alternator noise. The noise slowly goes away as the static charge discharges through the receiver front end. Then the noise repeats as the antenna system recharges. The pattern occurs with mobile and



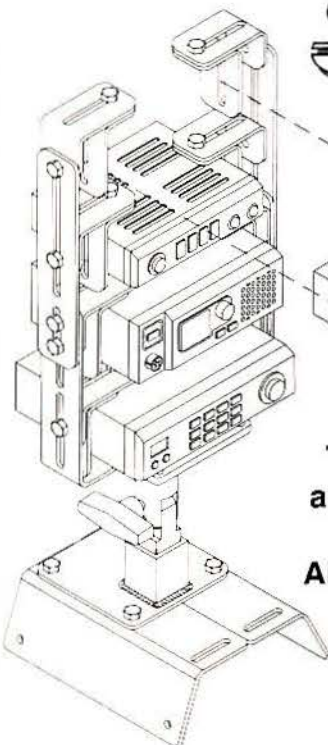
**Photo 1.** P-static and corona noise can be reduced or eliminated with wick dischargers. These static discharge devices bleed off the excess electrons, reducing undesired electrical noise and receiver desensitization.

fixed stations alike.

Data presented here indicate that p-static and corona noise can be reduced or eliminated with wick dischargers. (See Photo 1 above.) These static discharge devices bleed off the excess electrons, reducing undesired electrical noise and receiver desensitization. The wicks reduce a structure's discharge threshold by draining the charge before it reaches a level at which severe broadband noise is caused.

The wick is the type of device used by the aircraft industry to reduce electrostatic interference to airborne and ground station equipment. The difference is that this model has been optimized for antennas instead of airframes to ensure the antenna is not detuned, even when the wick is mounted on the antenna element.

Few aircraft manufacturers do not offer, at least as an option, a high-quality static discharger installation. These static discharge devices are just as effective




# SMC's

## "S2000" SERIES

**Stack-Mount Systems  
are designed for  
the installation  
of mobile  
communication  
systems incorporating  
multiple control units.**

**The Stack-Mounts are available in  
a variety of configurations utilizing  
different adjustment capabilities.  
All units are constructed from steel  
and aluminum components  
to provide a combination of  
high strength and light weight.**

**MADE IN THE U.S.A.**



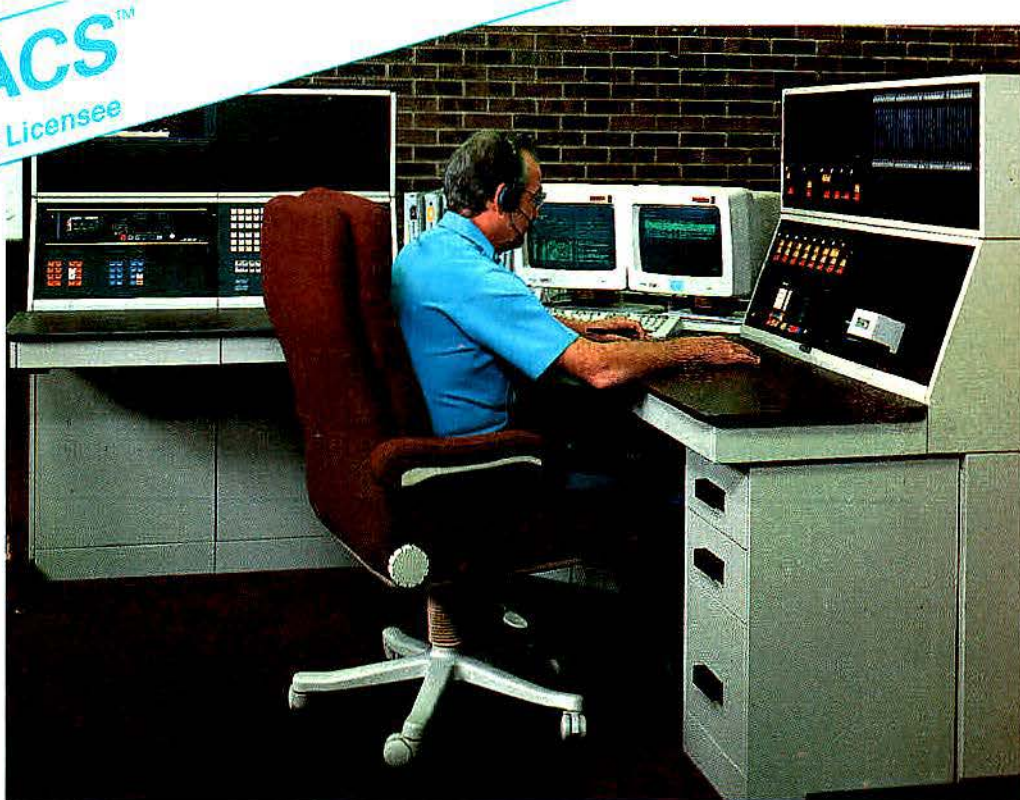
**For More Information Call or Write:**  
P.O. Box 1607 • Tomball, TX 77377  
(800) 527-1079 • FAX: (713) 259-7801

"providing solutions to all your installation challenges"

Circle (25) on Fast Fact Card



# When every second counts...



TDM-150: Our state-of-the-art, 120+ channel console

## Count on the reliability and performance of communications consoles from Orbacom

In an emergency, reliable communications are the lifeline for survival. That's why so many communications systems rely on Orbacom's CALIDA and TDM-150 consoles. Their superior performance and solid dependability have been proven in the most demanding applications.

If you need the control flexibility of a big console on a small budget, CALIDA is for you. CALIDA handles 16 channels, includes a multi-format paging and signalling encoder, is completely user programmable, and features a 12/24 hour clock, VU meter, alert tone, crosspatch, service intercom, desk mic with PTT and monitor switches, surge protection, and a wealth of other professional features.

If your service requires a state-of-the-art dispatch console, Orbacom's TDM-150 is the solution. TDM-150 is a custom system, so we'll configure it the way you need it — up to 120 channels or more and 120 positions. TDM-150 uses time-

division multiplex (TDM) digital audio processing and complete microprocessor control. Operation is simple and menu-driven. Reliability is ensured through surge protection, self-healing diagnostics, and battery backup. Eight levels of multi-channel radio and telephone patch may be run simultaneously, and an internal paging signalling encoder generates any sequence you'll ever need. Plus the best two-year console warranty in the business.



CALIDA: Big console flexibility for smaller systems



Mini-TDM-150 Desktop Console

Take your pick. CALIDA for professional performance in smaller systems. And TDM-150 for state-of-the-art performance on 120 channels or more. Either way you can count on Orbacom. Our communications consoles are the most reliable you can buy, and have been since 1970.

Call (609) 829-4455  
 and let Orbacom solve your  
 dispatching problems. Orbacom  
 Systems, Inc., 1704 Taylors Lane,  
 Cinnaminson, NJ 08077;  
 FAX: (609) 829-6980.



Circle (26) on Fast Fact Card



in eliminating the same problems from antennas and towers. They deliver results on long wires, dipoles, yagis for HF through UHF, verticals, TV antennas and satellite dishes during corona and p-static charging conditions. In many cases, the discharge wicks reduce the noise level several decibels under normal weather conditions.

In the aircraft industry, the standard

procedure for discharger wick ground testing is to insulate the wick from the airframe and monitor the discharge current. The aircraft is insulated from ground and exposed to an ion flooding fixture. The current discharge levels then are used to determine how many wicks are needed and in which areas they should be placed. Aircraft are subject to the influence of more variables

than antennas and towers are.

To test the dischargers, two identical 7-element 50MHz yagis were assembled and mounted 30 feet high (1.5 wavelength). One wavelength separated the yagis. Both were fed with equal-length feedlines. (See Figure 3 below). Both yagis were swept with a spectrum analyzer-tracking generator combination to verify their resonance at the same frequency.

## CUSTOM DISGUISE ANTENNAS

STI-CO's two-way antennas are *exact* replicas of the AM/FM antennas supplied with your car—GM, Ford or Chrysler.

Don't blow your cover—buy STI-CO.

The

**DISGUISE  
GUYS**

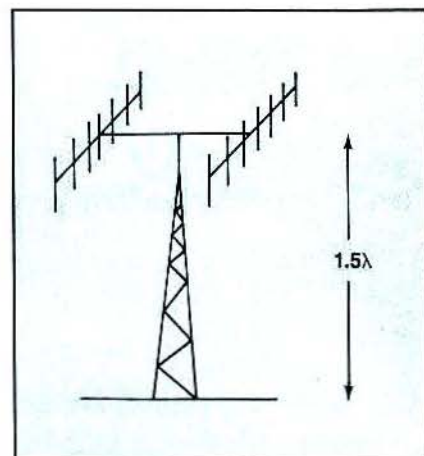
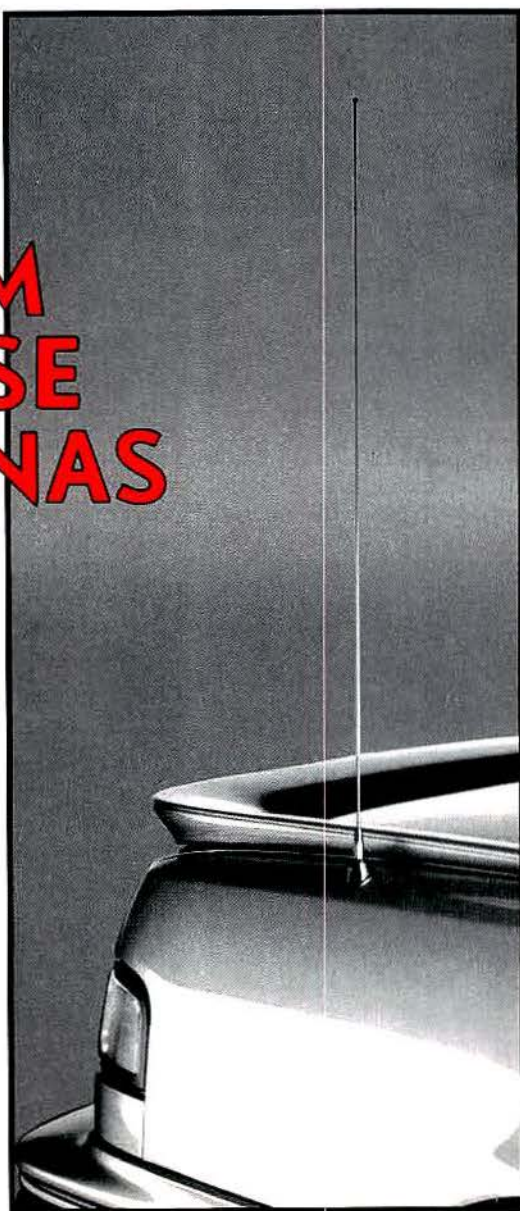


Figure 3. To test the dischargers, two identical 7-element 50MHz yagis were assembled and mounted 30 feet high (1.5 wavelength).

The antennas were lowered, and a static discharger was attached to each end of the boom on one yagi. (See Figure 4 below.) The yagis were raised back to 30 feet. The yagi without the discharger was used as a control antenna.

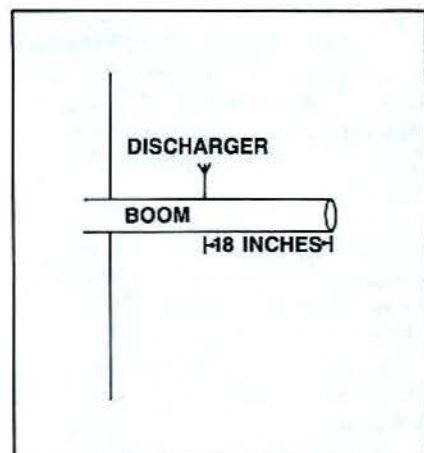


Figure 4. A static discharger was attached to each end of the boom on one yagi. The yagi without the discharger was used as a control antenna.



11 COBHAM DRIVE ORCHARD PARK, NY 14127-4187 (716) 662-2680 FAX (716) 662-5150  
Circle (27) on Fast Fact Card





# This Year's Hottest Gift Item

Loaded with features, the **COM-120A** continues IFR's tradition of supplying the most cost-effective, feature-intensive instruments in the industry. With the **COM-120A** you get

## as standard:

- 2  $\mu$ V receiver
- Antenna protection
- Split screen spectrum analyzer
- Cross-band duplex
- High resolution EL Display
- Quick-change, internal, rechargeable battery

## as options:

- Tracking generator
- Analog and digital signalling
- AMPS mobile station test
- CLEARCHANNEL LTR<sup>®</sup> radio test
- IEEE 488 interface

If these features are on your list of requirements, then the **COM-120A** should be under your tree.

*For additional information contact...*

CLEARCHANNEL LTR<sup>®</sup> is a registered trademark of IFR SYSTEMS, INC.


*Season's Greetings*

## IFR SYSTEMS, INC.

10200 West York Street  
Wichita, Kansas 67215-8935 U.S.A.  
Phone 316/522-4981  
TWX 910-741-6952, FAX 316/522-1360

Circle (28) on Fast Fact Card



The results are shown in Figure 6 on page 36. The reduction in corona discharge and p-static attributed to the dischargers is not trivial.

The noise measurements were made as an approaching weather front caused a few sprinkles of rain to fall as the noise level peaked. It does not have to be raining for corona and p-static discharge to take place. A weather front with embed-

ded charged clouds moving in the antenna's vicinity causes electrons to build up.

When the discharge threshold is reached and discharging begins, the noise starts. The object of using the wicks is to reduce the discharge threshold. With a lower threshold, electrons drain at a lower potential that does not cause noise or that causes less noise. If

the charging intensity is high enough, some noise will be heard. But the noise level is likely to be 20dB to 30dB less than it would be without the wicks.

Efforts were made to find the wicks' optimum mounting location. The first noise graph (Figure 6) was made with the dischargers mounted vertically, 18 inches from the ends of the 40-foot boom. Noise reduction was significant.

Next, the wicks were positioned on the ends of the boom and in the plane of the boom. (See Figure 5 below). Fig-

## Now, a two-way line you can count on.

Count on Mobile Mark to come up with this new, economical two-way antenna: shown with a black-chrome base and a 1/4 wave whip. Available for 140-950 MHz.

It's just one dependable part of our new roof and body mount antenna line that includes UHF, VHF and Low band antennas.

All are engineered for outstanding performance, and backed by solid sales support and warranty.

Count on Mobile Mark for continuing service long after the sale, too. Our 43-year reputation for responsive service is unequalled in the mobile communications industry. Call today.

# 1

**Quick Disconnect Mechanism** lets the whip come off easily.

# 2

**Spring Loaded Center Contactor** means quality reception that lasts.

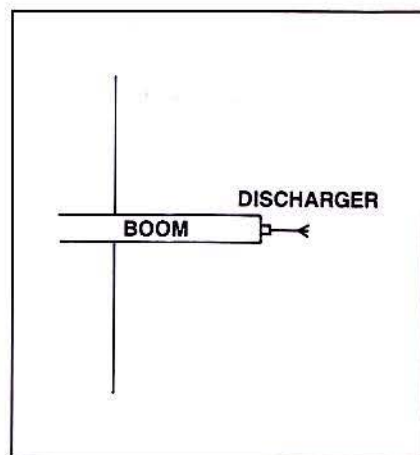
# 3

**Neoprene O-Ring Seal** effectively keeps moisture out of the connection.

**MOBILE MARK**  
COMMUNICATIONS ANTENNAS

3900-B River Road, Schiller Park, IL 60176 800-648-2800 or 708-671-6690

Circle (29) on Fast Fact Card



**Figure 5.** A second test was made with the wicks positioned on the ends of the boom and in the plane of the boom.

ure 7 on page 38 shows noise results of the Figure 5 wick position. The performance improvement probably results from the discharger being in a more prominent dc field area of the antenna.

Dischargers can be mounted vertically at the end of the boom if they are within three inches of the end.

Data are being collected with the dischargers mounted on the driven element of a seven-element yagi to compare the effectiveness of boom, driven element and parasitic element mounting positions.

Various methods were used to record the antenna and discharger performance. Noise graphs were prepared from data collected by an eight-channel analog-to-digital converter connected to an IBM PC-AT-compatible computer.

A three-range ammeter was built to measure individual discharger currents during various weather conditions. The ammeter read in 100-picoamp, 100-nanoamp and 100-microamp scales.

Once a normal baseline is established



# Who Makes The Smallest Intrinsically Safe Portable? ICOM!

## IC-H28

VHF Transceiver

## IC-U28

UHF Transceiver

ICOM presents the smallest Intrinsically Safe portable tough enough for use in industrial environments— without sacrificing functionality.

Small size by itself is no benefit if you can't see or use the controls in real life. We made the U28/H28 small on the outside, but the controls are big and the functions accessible, even with gloves on.

The U28/H28 has the full Factory Mutual IS rating, and meets MIL 810C/D specifications. We put in the safety and ruggedness industrial users need.

- Full 5w power when you need it
- 1 or 2w for extra battery life
- Weather, dust and atmosphere-resistant case
- 16 fully programmable channels
- Full bandwidth operation
- PC programmable
- 2 internal expansion slots
- Optional DTMF keyboard
- Optional speaker/microphone
- Optional encoder units

For more  
information call

**1-800-426-7983**

Circle (30) on Fast Fact Card

ICOM America, Inc., 2380-116th Ave. N.E.  
Bellevue, WA 98004

All stated specifications are subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions. U28992  
© 1992 ICOM America, Inc.

**ICOM**



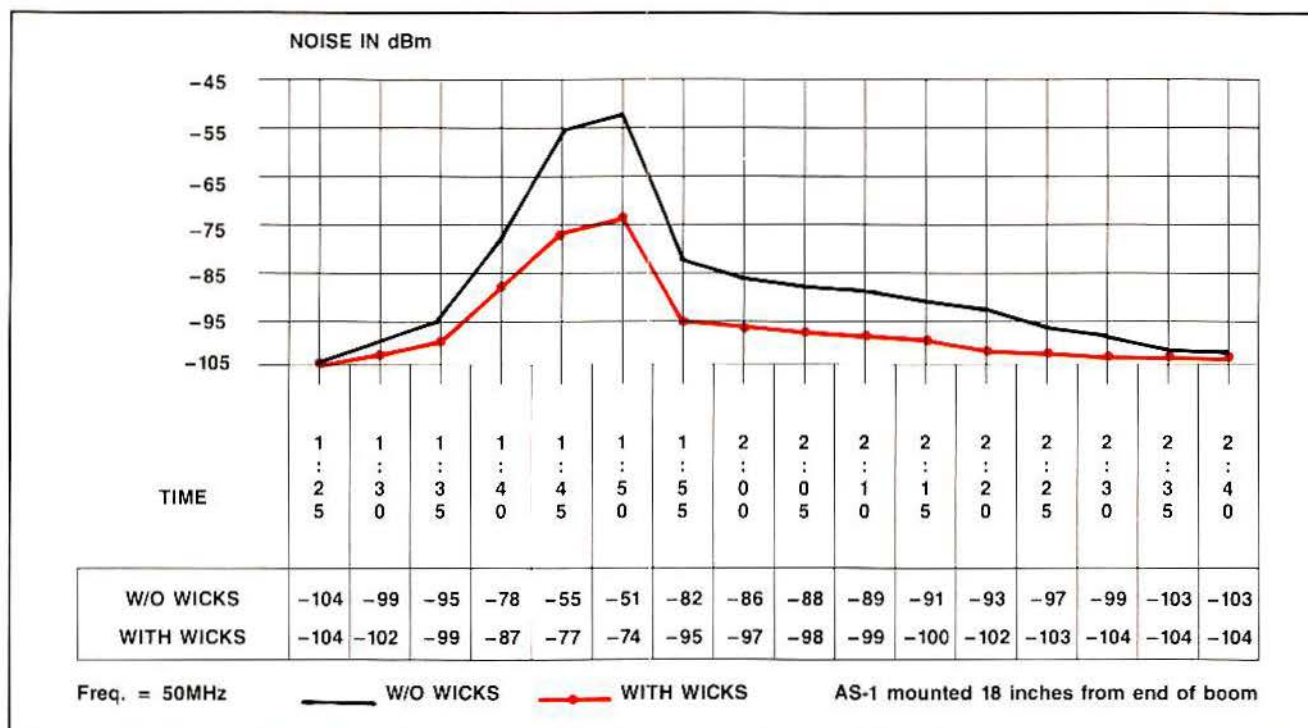


Figure 6. Noise measurements were made on the yagi test setup shown in Figure 3 as an approaching weather front caused a few sprinkles of rain to fall and the noise level peaked. It does not have to be raining for corona and p-static discharge to take place. The graph compares noise received on the yagi with dischargers with noise received on the yagi without dischargers.

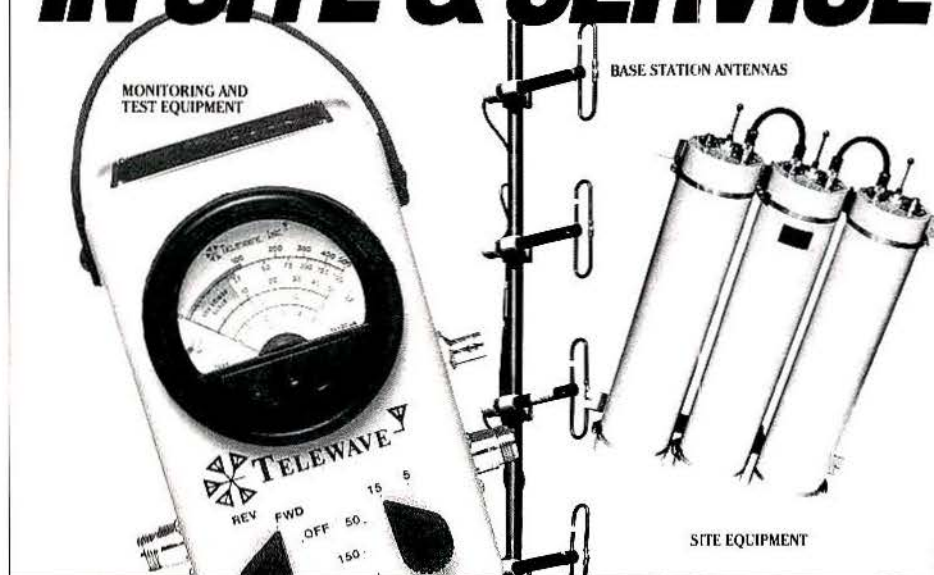
# TELEWAVE & HUTTON COMBINE THE BEST IN SITE & SERVICE

You can count on Telewave's performance-packed site equipment, base antennas and test equipment combined with Hutton's fast, no-hassle service to make your job easier. Call us toll-free for technical advice and speedy delivery.



Dallas, Texas  
214-239-0580 FAX 239-5264  
800-442-3811  
Norcross, Georgia  
404-729-9413 FAX 729-9567  
800-741-3811  
Hutton National  
Humble, Texas  
713-446-4050 FAX 446-5779  
800-325-8950  
Communications Works  
Denver, Colorado  
303-820-2929 FAX 820-2809  
800-726-6245

**HUTTON HAS WHAT IT TAKES**



Circle (31) on Fast Fact Card



# AutoPath . . .

## *Why Didn't I Think of That?*

**... the Model 49  
LTR Controller  
NOW has the  
Power to Control  
the Call-Transfer Feature  
of the Telephone Company**



Zetron is always thinking of new ways to expand their customers' revenue-generating services. The Model 49 Trunking Repeater Manager, already the industry leader, now has the power to offer new advanced features with the AutoPath software option.

- **Automatic Networking**
- **Search-and-Find Roaming for Interconnect Calls**
- **Call Forwarding; Ring-No-Answer Forwarding**

Upgrade your Model 49s with AutoPath or buy new Model 49s configured with AutoPath. Let the power of AutoPath go to work generating additional revenues for you.

Find out more about how the Model 49 makes good sense and how it makes you money. The Model 49 provides LTR logic, interconnect (RIC), validator, airtime accumulator, and built-in modem -- all in one package! **Don't ponder any longer. Call, write, or send us a fax today!**

12335 134th Ct. N.E.  
Redmond WA 98052



Phone: (206) 820-6363  
Fax: (206) 820-7031



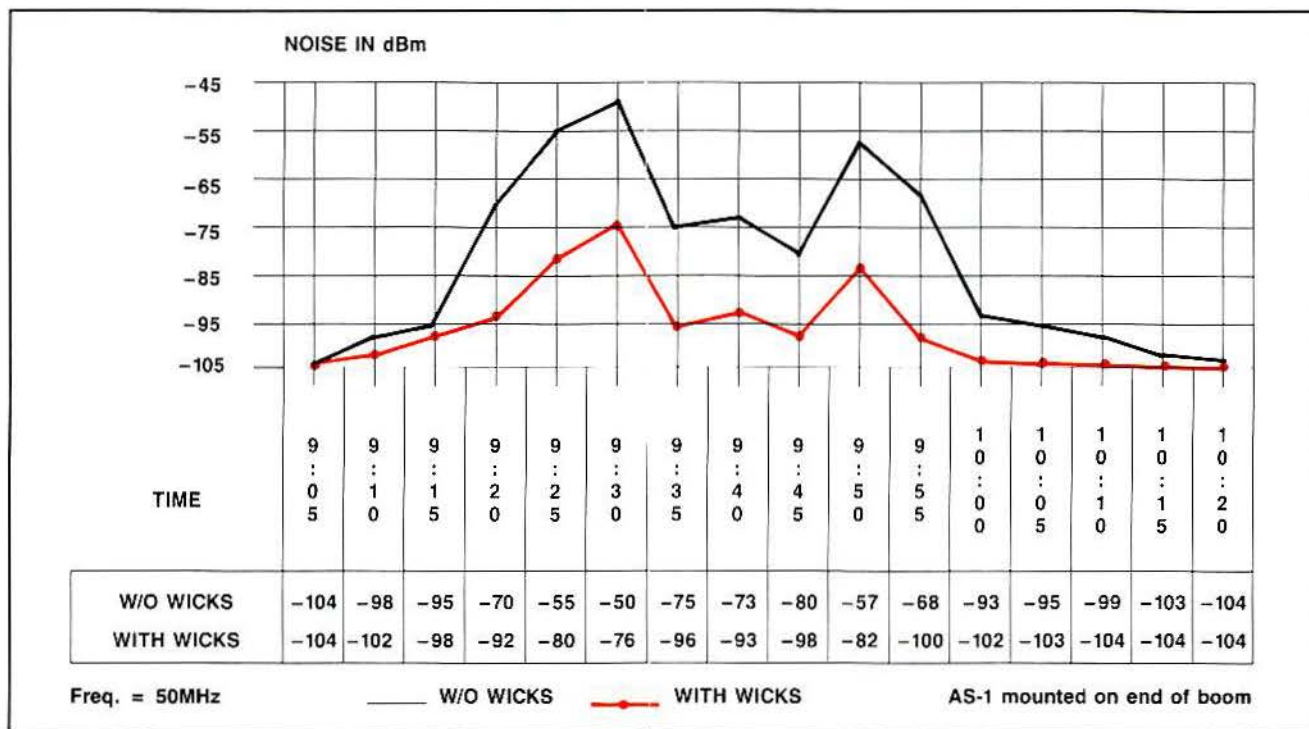


Figure 7. A second set of noise measurements made with the wicks positioned at the ends of the boom shows improved performance that probably results from the discharger being in a more prominent dc field area of the antenna.

# Professionals prefer Multiplier.

Professionals know they can depend upon Multiplier 2-Way Radio replacement batteries to deliver:

- Unbeatable performance • Highest available capacity
- Unsurpassed reliability • Form, Fit and Function that meet or exceed O.E.M. • Fast order processing
- Made in U.S.A.



**Over 1000 batteries available for all 2-Way equipment.**



Call or write for our new 2-Way Radio and Cellular Catalogs.

Contact us for the name of your nearest Multiplier distributor.

Distributorships are available worldwide.



## Multiplier®

MULTIPLIER INDUSTRIES CORP.  
135 Radio Circle, P.O. Box 630 Mt. Kisco, NY 10549 U.S.A.  
Tel: 914-241-9510 Telex: 4932483 MULTUI FAX: 914-241-1103

Circle (33) on Fast Fact Card



# Standard's HX580T: Two Trunking Formats Plus 800 MHz Conventional!



## Three Times The Radio, Three Times The Features, Three Times The Value

Standard's new HX580T offers the best of both trunking systems in a feature-packed portable fully compatible with either EFJ LTR® or Motorola Privacy Plus® trunking formats.

It can even operate as a conventional 109-channel 800 MHz radio, supporting talkaround channels.

All with field programmability, high-speed priority scanning, graphic battery level display, two watt output, programmable DTMF, DCS, ANI & CTCSS, internal self test, and a Mil Spec rating.

The industry's best trunking handheld, delivered with the industry's best warranty, three year's parts and labor.

Count on Standard to deliver.

### A Privacy Plus® Trunking Handheld

*Fully compatible, with a full complement of convenient features:* Group Select, Subfleet Call, Fleet Call Encode, Fleet Call Decode, Call Alert, 5 Channel Restriction, Multiple Control Channels, Busy Scan Hold, Floating System, Quick Access and more!

### An LTR® Trunking Handheld

*Packed with features to maximize trunking convenience:*

Group Select, Block Decode, Block Decode Timer, Block Transmit Inhibit, Floating System Auto-Transmit, LTR® Talkaround, and more!

### A Conventional 800 MHz Handheld

*Loaded with unique features:* Group Select, Squelch Tail Elimination, CTCSS/DCS Lockout Talkaround, Monitor/Volume Set, DTMF ANI, Phone Interconnect Encode, Busy Lockout etc.

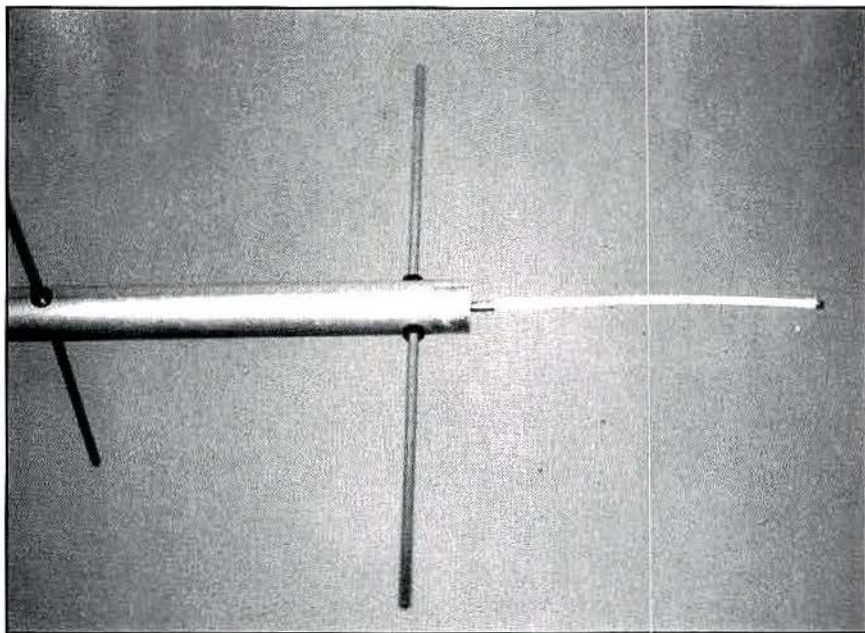


*Deliver The Best*

SCC Standard Communications, Land Mobile Division, 4876 West North Temple, Salt Lake City, UT 84116 800/767-6695 (FAX 801/369-4122)  
LTR is a registered trademark of EFJ. Privacy Plus is a registered trademark of Motorola.

Circle (34) on Fast Fact Card





**Photo 2.** A discharger mounted on the boom of a 430MHz, circularly polarized satellite antenna.

for fair-weather discharger current, changes in readings can detect an approaching front when it is still 20 miles

to 30 miles away. Using the ammeter in this way requires a resolution of at least 1.0 picoamp.

The onset of audible noise did not happen simultaneous with discharger increases above the normal baseline. Usually, the baseline current had to be exceeded by at least 10 times before detectable audio noise resulted. Nevertheless, the receiver front end can be desensitized by 10dB to 20dB before noise is heard.

#### Mounting

The dischargers are 0.187-inch (3/16")  $\times$  6.75-inches long. Each discharger requires one tapped 4-40 mounting hole. Only the 0.25-inch base of the discharger is metal, so antennas are not significantly detuned even when a discharger is mounted on an active element at frequencies below 470MHz.

Most antennas are at dc ground potential. With such antennas, no modification is required when a discharger is mounted. A discharger mounted on an element that is not dc grounded should be bypassed to ground with a 100K $\Omega$  or 1M $\Omega$  resistor to provide the dc path.

Photo 2 above shows a discharger

## PROVEN PERFORMERS - ECONOMY PRICED

### Rural Telephone System

Provides Wireless  
Phone Service



Low-cost alternative to wire-line service.

Provides full-duplex remote telephone service compatible with DTMF or rotary exchanges. The remote terminal provides ring voltage to activate any standard telephone set bell. Plugs into virtually any repeater system.

**Model RTS-25 \$499.00**

### Automatic Morse Code Identifier and Site Monitor



Microcomputer-controlled and totally field programmable, including the ID and all timing parameters. Provides inhibit inputs and an inhibit-release delay to prevent traffic interference. Meets all FCC requirements. The site monitor feature enables up to six site functions to be continuously monitored and to provide status information to a remote decoder.

**Model ID/SM-700 \$159.00**



2403 Commerce Lane  
Albany, Georgia 31708

Telephone: 912-883-4703  
Toll Free: 800-652-9296

Circle (35) on Fast Fact Card



# ...POWER ON WITH ASTRON DC TO AC POWER INVERTERS...



**Operate the following equipment from any 12vdc source including  
Cars, Trucks, Boats and RV's ETC.**

Laptop and notebook computers

Facsimiles

Battery Chargers for laptop & notebook computers, cellular phones and camcorders.

Computer peripherals, scanners and printers.

Stereos, VCR and TV.

Test equipment, power drills and other electronic equipment.

## SPECIFICATIONS

	PI-125	PI-250W	PI-600W
<b>Output power</b>			
30 minutes:	125 watts	250 watts	600 watts
Surge:	200 watts	500 watts	1500 watts
Continuous:	100 watts	200 watts	500 watts
Input Voltage:	10 to 15 VDC	10 15 VDC	10 to 15 VDC
Output voltage:	115 VAC RMS $\pm$ 5%	115 VAC RMS $\pm$ 5%	115 VAC RMS $\pm$ 5%
Output frequency:	60 Hz $\pm$ 2%	60 Hz $\pm$ 0.01%	60 Hz $\pm$ 0.01%
Output waveform:	modified sinewave, phase corrected	modified sinewave, phase corrected	modified sinewave, phase corrected
Efficiency:	90%	90%	90%
Low battery alarm:	10.7 V	10.7 V	10.7 V
Low battery shutdown:	10 V	10 V	10 V
Dimensions (H x W x L):	1.2" x 3.5" x 4.5"	1.5" x 4.5" x 6"	3" x 9" x 10"
Weight:	14 oz.	1.25 lbs.	5.25 lbs.
<b>Protection features:</b>			
Over temperature:	Electronic shutdown	Electronic shutdown	Electronic shutdown
Overload:	Electronic shutdown	Electronic shutdown	Electronic shutdown
Short Circuit:	Electronic shutdown	Electronic shutdown	Electronic shutdown
Reverse polarity:	Fuse	Fuse	Fuse

Circle (36) on Fast Fact Card

**ASTRON**  
CORPORATION

9 Autry • Irvine, CA 92718 • (714) 458-7277 • FAX (714) 458-0826



mounted on the boom of a 430MHz, circularly polarized satellite antenna.

You can demonstrate how effective the discharger is by insulating it from the boom and connecting a single wire to a zero-center, 150 $\mu$ A meter to ground, as shown in Figure 8 to the right. The meter should be protected with back-to-back diodes.

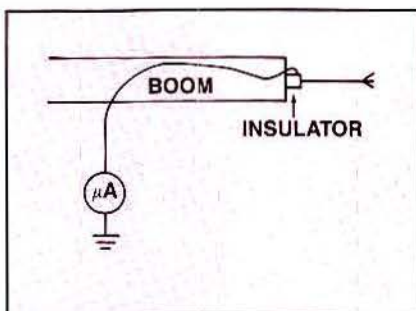
As much as 100 $\mu$ A of discharger current will flow when the noise level rises to 40dB above the ambient level. The readings may differ at various installations, but the correlation will be evident.

A zero-centered meter is used because the discharge can be positive-point corona or negative-point corona.

These dischargers are not lightning "deterrent" devices. Although they are installed in the most prominent dc field area, they may become "sacrificial" if lightning strikes, possibly reducing damage to more expensive equipment.

Once installed, dischargers require no maintenance. They rarely need to be replaced.

As a precaution, check them to be



**Figure 8.** To demonstrate how effective the discharger is, insulate it from the boom and connect a single wire to a zero-center, 150 $\mu$ A meter to ground. Protect the meter with back-to-back diodes. As much as 100 $\mu$ A of discharger current will flow when the noise level rises to 40dB above the ambient level. The readings may differ at various installations, but the correlation will be evident.

sure they show continuity with whatever they are attached to. There must be an electrical path from the discharger to the structure. Other than checking for physical damage and a satisfactory mechanical connection while you perform other antenna and feedline inspections,

you will find the dischargers are maintenance-free.

A discharger's resistance is in excess of 20M $\Omega$ , so to measure its resistance, a driving potential of at least 100V may be required. Take care when making measurements at a voltage that high.

#### References

1. "Origin of Lightning," Lockheed Service Digest.
2. "Cadweld" is a registered trademark of EIRCO.
3. *Reference Data for Engineers*, Seventh Edition, 1985.
4. Nickum, J.D., "The Effects of Precipitation Static," FAA Contract DTF A01-81-C-10007.
5. Robb, J.D., D.J. Brady and L. Donatich, "VHF/UHF Precipitation Static Interference," Lightning and Transients Research Institute, St. Paul, MN.
6. Truax, Robert L., "Dielectric Electrostatic Charge Reduction," Business Aircraft Meeting & Exposition, Wichita, KS, April 1981.



## Interceptor™

### Digital Paging System Analyzer

"Off the Air System Analysis"

**Turbo Charge your Digital Paging System!**

**Maximize pager capacity per channel!**

**Minimize busy hour delays!**

- \* Golay, NEC and Pocsag 512/1200.
- \* Real time display of all modes.
- \* Capcode, function code, pager type, synch code or preamble and data message.
- \* Batch fill and efficiency analysis.
- \* Break down of data stream to binary level.
- \* 24 statistical summary - pages, data words and addresses per second.
- \* Pager trap and logging.
- \* Cyclic page detection and alarm.
- \* Simultaneous Multi-Channel Operation

## Page Sitter™

### Page Monitoring and Retrieval System

**No More Missed Pages!**

- \* Tracks over 32,000 Digital Pagers Alpha or Numeric (expandable).
- \* Stores to individual password protected files for weeks or months.
- \* Records Time /Date, Capcode, Function Code, Pager Type and Data Message.
- \* Automatic Decoding of NEC, Golay, Pocsag 512/1200 Synch Codes 1 - 4.
- \* Works with all terminals.
- \* "Off The Air" - No hardware connections.
- \* Instant retrieval local or remote.
- \* Multiple channels.

## Pop - Page™

### A Pop Up Alpha Paging Program for Your PC

**Full featured at a fraction of the cost.**

- ✓ Unlimited Subscribers & Groups.
- ✓ Uses only 4.2K of Memory.
- ✓ Multi-tasking operation.
- ✓ Full IXO/TAP protocol.
- ✓ Wrap around page logging with recall.
- ✓ Windows & Lan compatible.
- ✓ Serial ports 1- 4.
- ✓ User selectable hot keys.

**Only \$19.95**

**Quantity Discounts Available.**

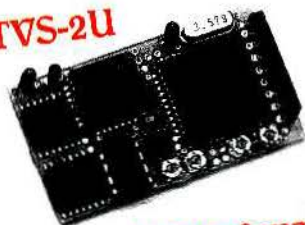
**Statistical Control Systems Corporation · 3430 27th Parkway · Sarasota, Florida 34235**  
**1-813-954-8816 · Fax 1-813-954-8624**



# WHY GAMBLE WITH SPEECH SECURITY?



**A** **TVS-2U**



## **Tactical Rolling Code Voice Scrambler**

- ♥ High-security scrambler with 100 million keyboard-programmable codes per system ID
- ♥ Thousands of unique system IDs available
- ♥ Greater than  $84 \times 10^9$  year pseudo-random encryption sequence period
- ♥ Resynchronization for late entry or fading
- ♥ Digitally controlled audio processing
- ♥ Easily passes through repeaters and voters
- ♥ Best recovered audio quality in the industry
- ♥ Selective Call (Individual & 3 Groups)
- ♥ ANI, Status, and Location Reporting
- ♥ Stolen Radio Destruct & Triangulation
- ♥ Monitoring of lost or stolen radios
- ♥ Requires U.S. State Department License for export

**K**

**TVS-2/Mic-Coder**



## **Tactical Rolling Code Voice Scrambling Microphone**

- ♥ Compatible with TVS-2 scramblers
- ♥ Durable microphone with backlit keypad
- ♥ LEDs: scramble mode light, call light, & transmit light



**Q**

**MTSS-M2**



## **Full-Duplex Rolling Code Mobile Telephone Scrambler**

- ♥ Millions of programmable code keys
- ♥ Digitally controlled audio processing
- ♥ Greater than  $84 \times 10^9$  year pseudo-random encryption sequence
- ♥ Employs RJ45 connectors for simple installation in Cellular mobiles and transportables
- ♥ Works with Midian MTSS-B series scramblers installed at IMTS or Cellular Switch
- ♥ Requires Keyloader programmer and U.S. State Department License for export

**A**

**10** **VPU-7**



## **Smallest Simplex Inversion Scrambler**

- ♥ Ultra-thin simplex inversion scrambler
- ♥ Single code scrambler
- ♥ Anti-aliasing input filter
- ♥ Crystal controlled for high stability
- ♥ Excellent recovered Audio Quality
- ♥ Available with flying leads or optional socket

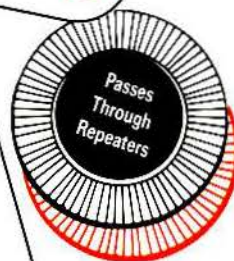


**J** **VPU-2**



## **Subminiature Tunable Voice Inversion Scrambler**

- ♥ Easily tuned with high-stability 15-turn trim pot
- ♥ Anti-aliasing input filter
- ♥ Six-pole tracking output filter
- ♥ Simplex operation
- ♥ Excellent recovered audio quality
- ♥ Available with flying leads



## With a Hand Like This, You Can Bet on Midian

To Order Call Toll Free: 1-800-MIDIAN'S

Telephone: (602) 884-7981

FAX: (602) 884-0422

# MIDIAN

World Leader in Innovative Communications Technology

**MIDIAN ELECTRONICS, INC. / 2302 East 22nd Street / Tucson, Arizona 85713**



# How to configure linked radio networks

*Wide-area radio communications system coverage can be achieved with multiple sites linked into a network. Here are some considerations for choosing between half-duplex and full-duplex configurations.*

By A.O.J. Woodfield

Linked radio networks provide wide-area coverage by connecting individual radio repeaters or base stations with radio links, microwave links or traditional cable pairs.

Many linking methods are available. Some are relatively complex, such as voting system combining.

Simpler linking methods are available, such as half-duplex and full-duplex linking. Properly configured, these networks support continuous-tone controlled squelch system (CTCSS) signaling.

Figure 1 below shows a conventional wide-area linked system with four sites linked via UHF radio. A repeater or

base station at each site provides local-area mobile coverage.

## Linking methods

► Half-duplex linking provides a connection that is used in only one direction at a time. An in-vehicle cross-band link that uses a pair of mobile units connected back-to-back is a common example.

► Full-duplex linking provides a two-way link in which speech or data traffic or both can flow in both directions simultaneously. Telephones and cellular radios are examples of full-duplex links.

Incidentally, the term "full-duplex base station" refers to a receiver and a transmitter operating at a remote site, perhaps in full duplex, where the received audio is not retransmitted over the transmitter at the same site. A taxi

dispatch system in which car-to-car transmissions are not desired, only a link between each mobile and the dispatcher or control center is an example.

In standard mobile radio networks it often is quite satisfactory to use the more limited half-duplex linking techniques. Half-duplex linking normally costs less because less equipment is required. Nevertheless, full-duplex linking provides some advantages and may be essential for some system applications.

Figures referred to in the following text show the wiring required at each site. Some details are omitted to keep the diagrams as clear as possible, and some assumptions are made about input and output signals, including:

- Active LOW PTT (push-to-talk) and Rx Gate (carrier-operated relay [COR] signal or Receiver Gate signal) signals are assumed in all of the diagrams. In other words, a ground on the PTT input turns on the transmitter, and when the receiver receives a valid signal, the COR or Rx Gate signal line goes to ground.

Some alternate systems may use -48Vdc signals, active HIGH PTT lines or even loop-keying or tail-keying signals. They all are similar to the system shown here, but they require slightly different circuit arrangements to provide the same functions illustrated.

- Duplexers and antennas are not shown.

- Power supply details are not described.

## Half-duplex linking

The major advantage of half-duplex linking is simplicity. With simplicity comes reduced cost, not only from a

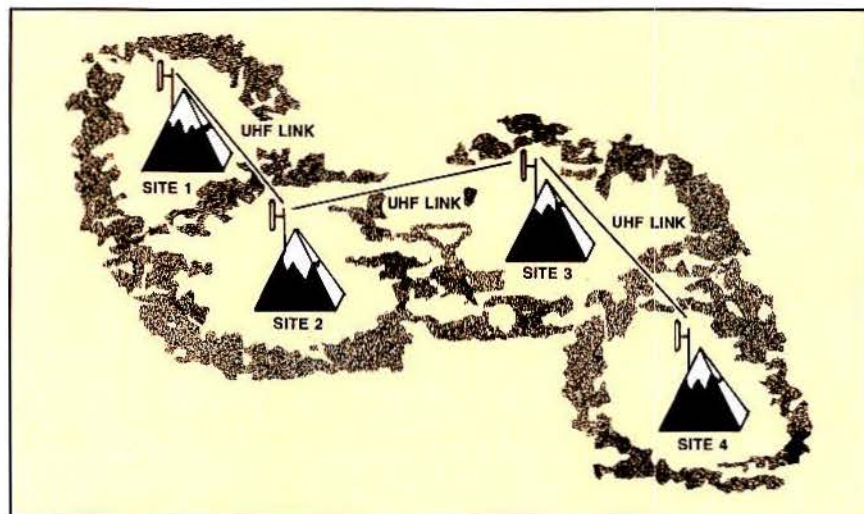


Figure 1. This conventional wide-area linked system has four sites linked via UHF radio. A repeater or base station at each site provides local-area mobile coverage.



**THE UNIVERSE IS UNFOLDING AS IT SHOULD**

**LIBERTY™... the future**



#### **ENHANCED 9-1-1 FEATURES**

##### **ANI/AU display**

Integrated Selective Router based on ANI or trunk selective routing

All traditional E9-1-1 features:

- ▲ Manual ringback
- ▲ Forced hold
- ▲ Forced release
- ▲ Automatic redial and speed dial
- ▲ Selective transfer with informer
- ▲ Call waiting queue with display

Multiple conferences

Integrated ACD

Click-free monitor

Intercom between any position

Call-taker note taking with screen transfer between positions

Call history printout

Softkey ANI call-back

Panelmount or desktop configuration for E9-1-1 and mobile radio application

#### **MOBILE RADIO FEATURES**

Compatible with EGE's most advanced 16-PLUS™ radio trunking system

Full APCO-16 compliance

Most conventional features:

- ▲ Multifrequency operation
- ▲ Repeat disable
- ▲ Voice guard
- ▲ RCU operation with disable
- ▲ Mobile ANI and GESTAR
- ▲ Tone, DC and E&M signalling

Patching between any channels

Simul-select for any channels

Console monitor

Base station intercom

Integrated paging for all formats

Voter control and display

Alert tones, emergency option

Circle (41) on Fast-Fact Card



#### **FUNCTIONS AND FEATURES:**

- ▲ Integrated E9-1-1 and mobile radio dispatching
- ▲ Even the small desktop can interface locally to sixteen radio channels, ten 9-1-1 trunks or CO lines
- ▲ Consoles can be paralleled with non-disturbing circuit sharing
- ▲ Paralleled consoles can be in close proximity or remotely located
- ▲ Digital T1/E1 trunks between clusters of paralleled consoles
- ▲ Digital audio processing and switching
- ▲ Consoles can be hooked up to sophisticated COM-NODE™ MRC switch
- ▲ Built-in battery back-up even for smallest desktop version

Sales Offices : Pennsylvania (412) 682-2179, Fax: (412) 682-0724  
Connecticut (203) 350-2658, Fax: (203) 350-3911  
Canada (819) 778-2053, Fax: (819) 778-3408



CML Technologies Inc., 75 Boul. de la Technologie, Hull, Quebec CANADA J8Z 3G4



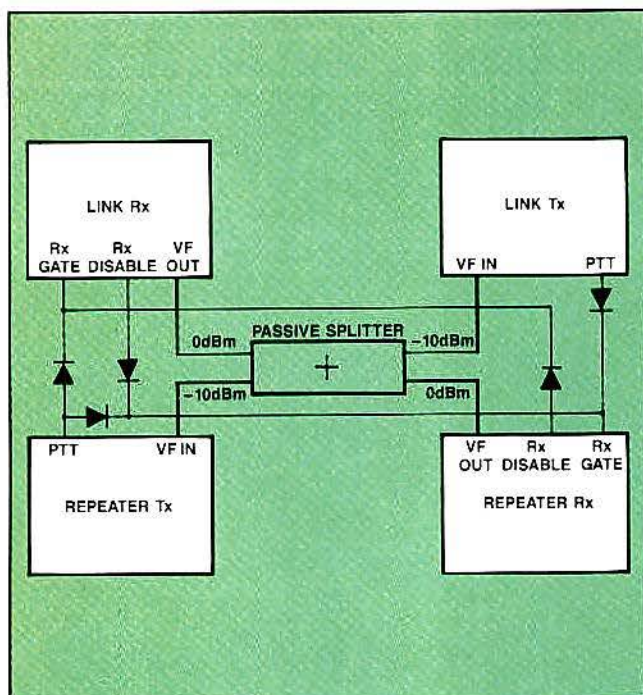


Figure 2. This is the wiring diagram for an end terminal site, such as Site 1 or Site 4 in Figure 1. In this case, the system uses repeaters at each site to repeat the received signal at the same site for other mobiles in the area to hear.

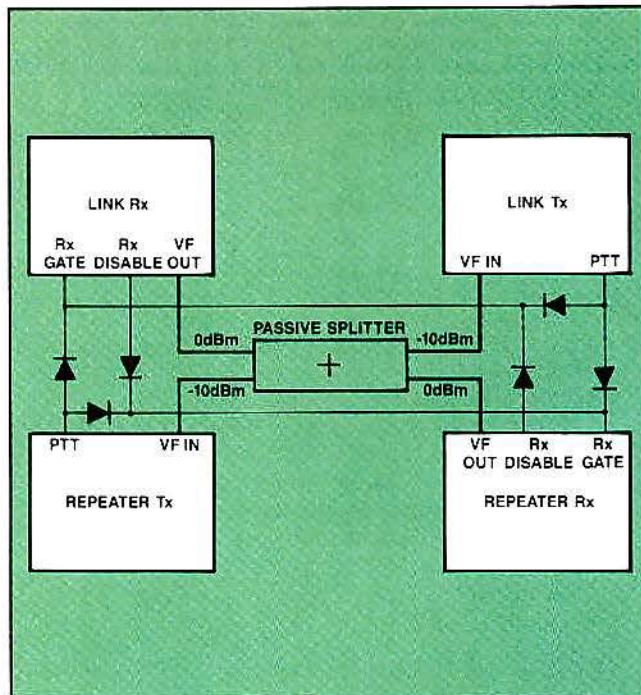


Figure 3. Midway sites differ slightly from terminal sites in half-duplex linked systems—one diode is added. To let either end of the system to receive signals from the opposite end, intermediate sites must have full-duplex links.

# AR2400

## RF MODEM/PRINTER

### AN AFFORDABLE APPROACH TO DATA RADIO

The AR2400 is an inexpensive AX.25 Packet Terminal complete with built-in printer—perfect for dispatch operations where vehicles may be un-attended or a printed record of calls is desired. Messages can be coded for security. Call for details.



**HENRY  
RADIO**

2050 S. Bundy Drive  
Los Angeles CA 90025  
Toll Free: 1-800-877-7979  
Or: 1-310-820-1234  
FAX: 1-310-826-7790



### ALSO IN STOCK:

AEA DATA  
AOR  
ASTRON  
BECKMAN  
BIRD  
CENTURIAN  
CUSHCRAFT  
FANON  
HENRY  
HOXAN  
ICOM  
JABRO  
KANTRONICS  
LARSEN  
MAXON  
OPTO  
PIPO  
RADIUS  
TEMPO  
UNIDEN  
YAESU

reduction in system equipment such as audio splitters, combiners and antenna duplexers, but also from reduced maintenance costs.

In the half-duplex system, the link connects audio from one base station to another, or from one repeater to another, in only one direction at one time, retransmitting the audio as required at each of the sites in turn.

Figure 2 above shows an example of the wiring for an end terminal site, such as Site 1 or Site 4 in Figure 1. In this case, the system uses repeaters at each site to repeat the received signal at the same site for other mobiles in the area to hear.

In addition, the system links the received signal from the terminal site to other sites in the system. Diodes provide the connection paths between the Rx Gate output signals and the PTT inputs of the local repeater transmitter and the link transmitter.

The two extra diodes connecting with the Rx Disable inputs on the receivers ensure signal collisions do not occur. For example, if the link receiver is busy and its audio is being retransmitted by the local repeater transmitter, then if a local mobile tries to call (perhaps because the mobile operator has his vol-



# THREE DIFFERENT MICS. THE SAME EXACTING SHURE STANDARDS.

If you're looking for a high-quality mic with the features you need at a price you can afford, Shure has the answer. Three mics designed to fit the needs and budgets of practically any user and built tough to give you the reliability you've come to expect from Shure.

**885TT DTMF – QUALITY THAT'S AFFORDABLE.** The 885TT gives you an unbeatable combination of economy, dependability, audio quality, and ease of use. It's a continuous-tone DTMF microphone that sets new standards for value and performance.

Features include:

- Illuminated keypad – designed to last and requiring no extra wiring in most cases.
- Million-Cycle Leaf Switch™ – a Shure exclusive, giving you longer trouble-free use.
- Positive tactile feel keys and audible tone to help make number entry easy and accurate.
- Externally adjustable audio and DTMF levels for easy installation.
- Tailored frequency response and Top-Talk Sound Channels™ provide optimum clarity and intelligibility.

**890TT DTMF – THE PROGRAMMABLE CHOICE.** The 890TT is a burst-mode DTMF microphone with all the features of the 885TT, plus programmable functions, including:

- Auto-dial feature with ten memory locations (up to 16 digits each).
- Last number redial.
- Lithium battery keeps the programmed memory safe for years.

**590T – A DYNAMIC PERFORMER.** The 590T, featuring a Shure amplified dynamic cartridge, is ideally suited to a wide range of mobile installations. Tailored frequency response provides optimum voice articulation while it discriminates against other sounds. The 590T is a workhorse designed to provide trouble-free service under the harshest conditions.

**ALL FEATURE THE SPEED, VERSATILITY AND COST-SAVINGS OF MODULINK® TECHNOLOGY.** All three mics are part of Shure's patented ModuLink System 1. Modular cordsets allow these mics to plug instantly into virtually all of the most widely used radio transceivers with no hardwiring – making installations and cable replacement, literally, a snap. Replaceable cordsets also help reduce inventory and lower repair costs.

**THE FINAL WORD ABOUT QUALITY.** At Shure commitment to quality is not simply talk. You'll be able to see and feel the quality of our mics as soon as you pick one up. Because we test them tougher, our mics last longer and perform better.

**CALL 1-800-257-4873.** We'll rush you a free catalog explaining, in detail, all the features and benefits of Shure Communication mics and a complete radio compatibility chart.



## SHURE®

COMMUNICATIONS PRODUCTS

Circle (42) on Fast Fact Card



ume control turned down), the diode going to the repeater Rx Disable input prevents the repeater receiver gate from keying the system.

Similarly, if the local repeater is being used and a call is made from another site, a possibility in such systems because of keying delays, then the link receiver is prevented from opening by this Rx Disable logic.

The passive splitter in Figure 2 frequently is a simple resistor splitter-combiner that allows the audio to be split around the site equipment.

The four-port unit shown illustrates the signal level losses of a four-port, 600Ω, fully balanced unit that I often use. The unit typically has port-to-port loss of about 10dB. This unit may sound complex, but it consists of a small

25mm x 25mm printed circuit board with eight resistors.

The midway sites differ only slightly from terminal sites in half-duplex linked systems. Figure 3 on page 46 shows the difference—one extra diode added. To allow for either end of the system to receive signals from the opposite end, these intermediate sites must have their links operating in full duplex. These sites may receive a signal from a downstream site, for example, and must retransmit it locally on the repeater transmitter.

Then, as distinct from an end site, it also must retransmit the same signal upstream to the next site, where the signal is transmitted again on the repeater, for the benefit of local mobiles in the coverage area.

The extra diode keys the link transmitter, a function not required on an end terminal site. Note that the link receiver does not operate continuously, nor can the repeater receiver locally receive

*The major limitation of half-duplex linking involves link timing.*

any signals from local mobiles while the link receiver is receiving signals from the remote site because these signals are retransmitted locally by the repeater transmitter.

The Rx Disable diodes on the repeater receiver would not be necessary where mobile transmitters are prevented from being keyed while a sign is being received at the mobile. But with this diode in place, even when such protected mobiles are used, it provides low-cost assurance against the possibility of a high-power mobile attempting to access the system from a weak-signal area.

#### Half-duplex limitations

The major limitation of half-duplex linking involves link timing. If a signal arrives at a repeater receiver, then typically it may take around 300mS for that

# TAD

*...the Right radios for any job...*

## TAD M8

Covers 138-174 Mhz band or  
406-470 Mhz band  
99 Channels  
8-40 Watts adj.  
Field Programmable  
Priority Scan and CTCSS

## TAD MD150

Synthesized 40 channels plus  
One priority channel  
30 Watts  
Compact Size

## TAD RADIO

of Canada Inc.

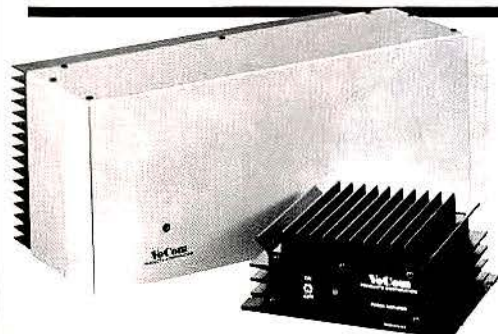
# (509)326-1511

612 N Maple, Spokane WA 99209      In Canada (604)545-1150



Circle (39) on Fast Fact Card

# BIG or SMALL We Have It All!



## POWER AMPLIFIERS

**FOR ALL INPUT LEVELS**

- VHF Low Band to 300 watts
- VHF High Band (140-200 MHz) to 500 watts
- UHF Low Band (400-550MHz) to 350 watts
- UHF High Band (800-960MHz) to 140 watts
- True continuous rating at high ambient temperatures
- FCC type accepted

**VoCom / RF Corporation**  
 Quality since 1979  
 1-800-USA-MADE  
 (1-800-872-6233)  
 FAX 708/924-9078

Circle (40) on Fast Fact Card



# 24 HOUR RECORDING



## THE RELIABLE WAY

We just put 24 hours of information into a single, easy to handle, easy to load, easy to store VHS tape.

Introducing the TEAC CR300 series communication recorders. They combine the convenience of 24 hour recording on a single VHS tape with the fixed-head reliability of open reel recorders.

The CR300 series can record up to 20 individual channels of audio. With TEAC'S VHS format your recordings are protected inside a compact cassette. So, you don't have to worry about all the problems of handling and storing tape reels.

Additionally, our single VHS transport design saves space, making it the perfect choice for desktop and rack mount installations. The reliability and performance of the CR300 series is enhanced by the features you'd expect from open reel recorders like serial, parallel and redundant operation. And you can configure the CR300 series to meet virtually any system requirement.

So, if you're looking for 24 hours the reliable way in one convenient package call TEAC, the leader in communication recorder design.

From the company that set the standard for VHS fixed-head recording.



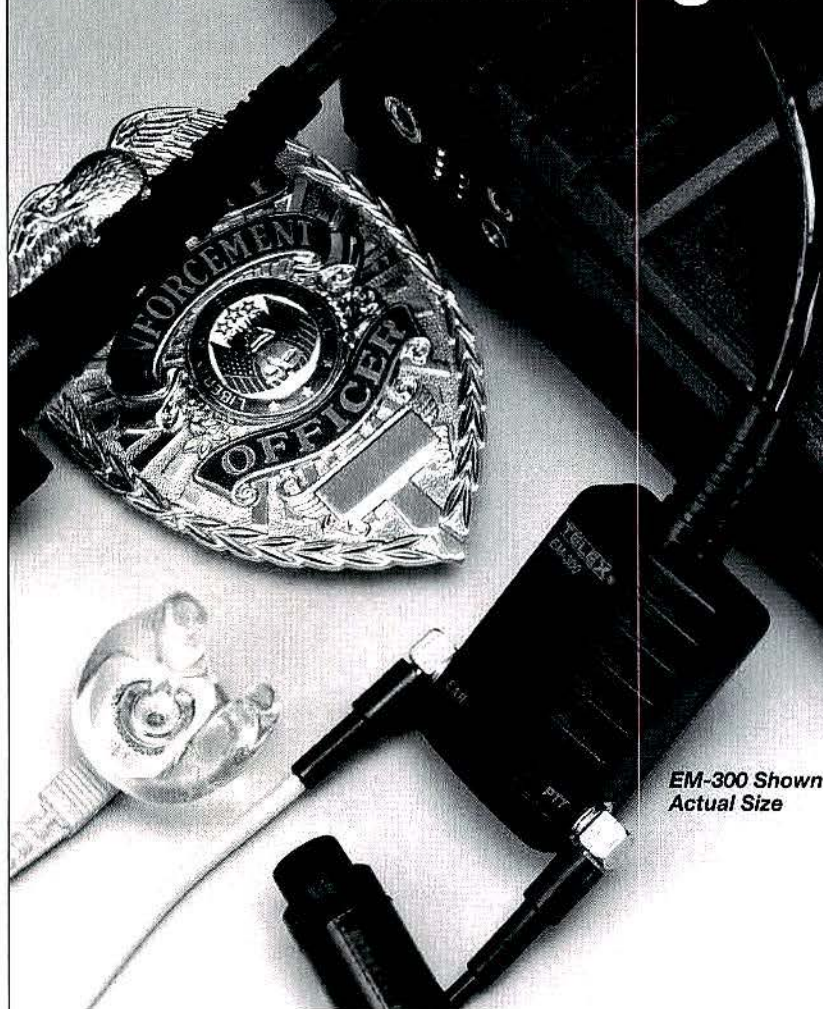
**TEAC**  
Information Products Division

TEAC AMERICA, INC., 7711 TELEGRAPH ROAD, MONTEBELLO, CA 90640, (213) 726-0303 EXT. 461.

Circle (44) on Fast Fact Card



# Ear-Mike® With Hidden Advantages



EM-300 Shown  
Actual Size

## Telex EM-300 Reliable and Discreet

**NEW!** Our smallest Ear-Mike yet, the EM-300 delivers the performance you expect in a size that may surprise you. The easy to conceal unit is a discreet 1½" long, 1" wide and ½" thick. But it contains all the power you need for covert communications.

The EM-300 features an exclusive *signal shaping* circuit, which reverses loss in intelligence caused by digitally encrypted signals. And because it derives power from the portable radio, no batteries are required. The EM-300 may be purchased with a palm, ring or velcro push-to-talk switch for virtually hands-free operation.

Unlike our competitors' expensive "disposable" products, the EM-300 features removable PTT and ear cords, so in case of damage, you can replace *them* instead of the entire unit. The back panel also removes for easy servicing or replacement of radio cable.

You can depend on the EM-300 Ear-Mike for discreet communications. To find out more, contact Telex Communications, Inc., at 9600 Aldrich Ave. So., Minneapolis, MN 55420, (612) 887-5530.

©1992 Telex Communications, Inc.

# TELEX

signal to appear at the far end of a four-site network as shown in Figure 1.

This time consists of a 50mS delay at the repeater receiver for it to gate; another 30mS for each link transmitter to turn on; 50mS for each link receiver to gate, and finally 30mS for the remote repeater transmitter to turn on.

These figures are fairly typical of most manufacturers' transmitters and receivers, and they assume good signal levels throughout the network. If weak signals arrive, then receivers may take significantly longer to open.

If the system uses CTCSS, then delays really start to accumulate. With mid-range CTCSS tones, decode delays are about 90mS, giving around 400mS link delays from end to end. And if

*If weak signals arrive,  
then receivers may take  
significantly longer to  
open.*

CTCSS is used on the link equipment too, then the total delay may be as long as 600mS.

With radio systems that carry only voice traffic, these delays usually are acceptable. Using CTCSS can be an advantage in linked networks of this type, in which users might use one CTCSS tone to access the local repeater only, and a second CTCSS tone for link access. This adds considerably to system flexibility.

If the linked system is used for data, as well as voice, then these delays result in some lengthy data transfers, particularly when packet protocols that required frequent hand-shaking among users are involved. An example of how much slower data transmission can be in a CTCSS-linked network illustrates the point.

Assume two users are communicating using 2,400bps modems. One user is sending a medium-length message of two lines of 32 characters, a common length in dispatch-type operations. The



# SCALA

PROUDLY PRESENTS

# AMERICELL™

A NEW FAMILY OF PROFESSIONAL  
ANTENNA PRODUCTS FOR DIGITAL AND ANALOG  
RADIO SYSTEM APPLICATIONS

- Broadband 806-894 MHz
- Low VSWR (< 1.3:1)
- Extremely rugged construction
- Low weight and windload
- *Ghostly Gray* fiberglass radomes
- Easy mounting
- Famous Scala/Kathrein reliability
- Made In the USA

## SCALA ELECTRONIC CORPORATION

P.O. Box 4580 Medford, OR 97501 (USA)

Phone: (503) 779-6500

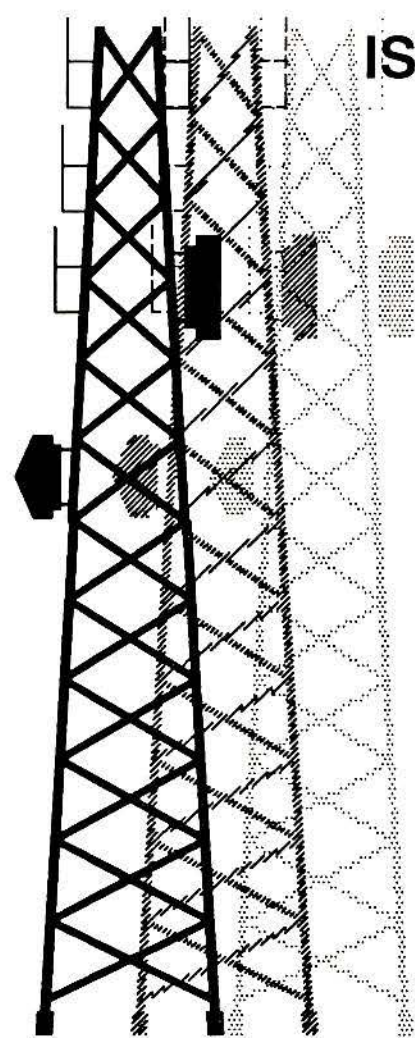
Fax: (503) 779-3991

AMERICELL™ is a trademark of Scala Electronic Corporation



# Where Are They Now?

Others may have faded ....**BUT**  
**TOWER STRUCTURES, INC.**



**IS STILL HERE!**

A recent advertisement in this publication caused concern among our customers. Why? They were concerned that the service and dedication which they have received for many years from **TOWER STRUCTURES, INC.** would no longer be available to them. We appreciate their loyalty and concern and would like to reassure all of our customers that despite the implication of the advertisement, **TOWER STRUCTURES, INC.** will continue to serve our customers as we have since 1968.

**TOWER STRUCTURES, INC.** will continue to provide in-house engineering by our team of registered professional civil and structural engineers. **TOWER STRUCTURES, INC.** will continue to manufacture only the best quality towers and shelters. **TOWER STRUCTURES, INC.** will continue to provide all phases of site construction, tower erection, and antenna installation with our own staff of full-time employees.

**TOWER STRUCTURES, INC.**



1869 Nirvana Ave.  
Chula Vista, CA 91911  
Phone: (619) 421-1181  
FAX: (619) 421-0533

**Self Supporting Towers**  
**Guyed Towers**  
**Concrete Shelters**  
**Steel Shelters**  
**Aluminum Shelters**  
**Monopoles**

*Serving the Industry since 1968*

message might be the transmission of name and address information.

Longer data messages sent via packets would be divided into packets of similar length. A typical format is used: eight bits; no parity; one start bit; and one stop bit. Including the CR-LF pair, the message has 66 characters. With 10 bits per character, the message length is 660 bits.

Assuming no transmission delays, the message takes 275mS to send (660 bits ÷ 2,400bps).

But adding the 300mS link delay for the system shown in Figure 1 with CTCSS extends the transmission time to 575mS, almost twice as long. If longer data messages are sent, the overall effective data rate rises, but not in the case of packet radio protocols because messages are broken into shorter packets by the modems.

*Full-duplex linking  
provides a bi-directional  
path for signals through  
the mobile radio network.*

This illustrates the advantages of a full-duplex linked network because the extra delays occurring in the half-duplex system are avoided. Unfortunately, full-duplex linked systems are more expensive and complex, so inevitably there is a tradeoff between design and operational requirements.

#### **Full-duplex linking**

Full-duplex linking provides a bi-directional path for signals through the mobile radio network. Full-duplex systems frequently are used, as in telephone networks. The difference in most mobile radio applications is that the mobiles in radio networks normally operate half-duplex.

A typical system layout in Figure 4 on page 54 shows only one midway site with a repeater, rather than the two midway sites that might be shown in an attempt to illustrate an equivalent of the Figure 1 network. A second midway site



# Introducing the first Dispatcher Workstation that lets you design your screens to fit your operating requirements.

The **ULTRA-COM PRO**, with its "touchscreen display," is the only workstation available today that permits the operator to program and modify the complete system.

With the exclusive "Screenmaker" and "Customizer" programs, you can easily design operating screens for function, appearance, color, and switch sizes and location. In addition, you can also develop functions unique to each operation.

The ULTRA-COM PRO's design is based on the concept of multiple workstations sharing common control electronics. This makes possible incorporating many enhancements required in modern dispatch systems.

The ULTRA-COM PRO comprises one main electronics package (MEP) and individual workstations. The MEP is housed in a standard equipment rack or equipment cabinet, and can be remoted up to 2500 feet from the workstations.

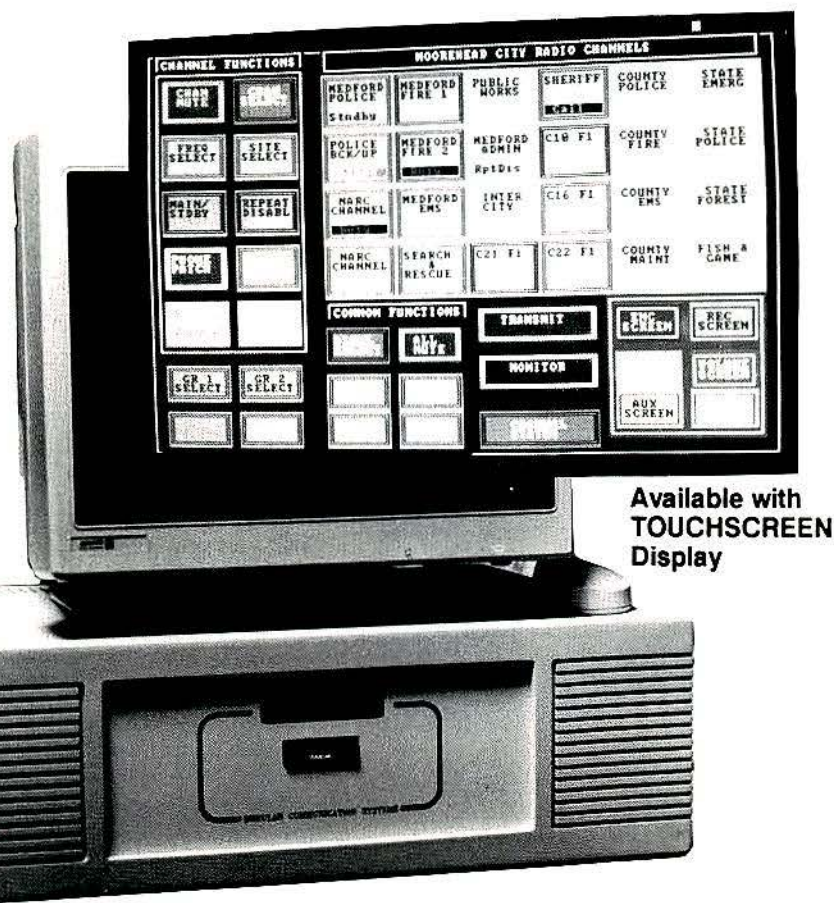
The heart of the ULTRA-COM PRO is a 386/486-based PC, supported by Intel's™ 16-bit 8097 microcontroller, and its family of support chips which provide the speed and reliability required in today's commercial and emergency communications environments.

Call, write or FAX for our **ULTRA-COM PRO** detailed literature and specifications.

## MODULAR COMMUNICATION SYSTEMS, INC.

13309 Saticoy Street  
No. Hollywood, CA 91605  
(818) 764-1333  
FAX (818) 764-1992

Circle (48) on Fast Fact Card



Available with  
**TOUCHSCREEN**  
Display



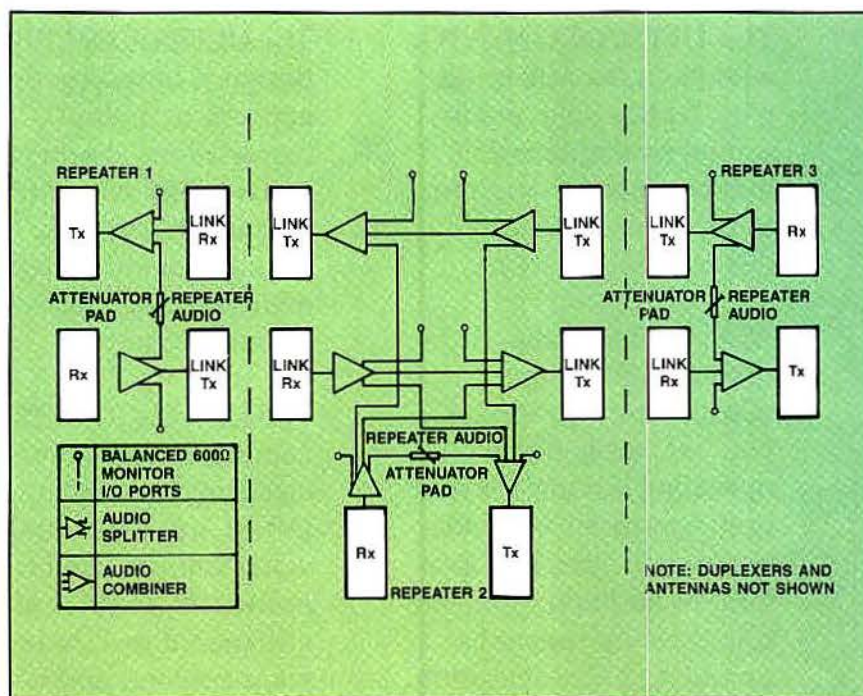


Figure 4. A three-site system uses one midway repeater site configuration. Additional midway sites, as in the four-site system shown in Figure 1, would be configured identically.

would be identical to the midway site shown in Figure 4.

An important feature of this configuration is the use of active splitters and combiners, which are necessary to provide both audio path isolation and correct levels throughout the network. The two audio paths within the linking equipment never are joined together. They meet only at repeater sites where the local repeater receiver signal is folded back to the local transmitter through the attenuator pads shown in Figure 4.

Audio normally is not folded back anywhere else to avoid problems such as oscillation, feedback and audible ringing in the system.

Preventing these problems is essential. Because this isolation is required, it is not possible to use the simple resistive pads that are used in the half-duplex system previously described.

Figure 5 on page 56 shows a typical active splitter-combiner. These can be quite complex units, especially for sites such as Figure 4's midway site where fully balanced 600Ω inter-unit audio is used.

Even so, this equipment still can be quite compact. In the case of Figure 4's midway site, two modules the height of

## When You Need Rechargeable Batteries...

## MAKE THEM JABRO!



Whatever your battery needs ... paging, communications, public safety, emergency lighting or other applications ... you can rely on JaBro as your **NUMBER ONE SOURCE** of supply. You will get fast delivery on these factory-fresh, high quality American made, nickel-cadmium batteries ... with the power built-in for peak performance.

Our expanded line is detailed in this 16-page catalog, complete with cross reference data and specifications. See for yourself why so many rely on JaBro - The House of Batteries - as their primary source.

Write, phone or FAX today for our catalog.

**JABRO Is A Factory Authorized Value Added Center For**



### JABRO Batteries, Inc.

1938-A University Lane, Lisle, IL 60532  
Phone: 708/964-9358 • FAX: 708/964-9081  
Telex: 281024 • Cable: JABROUSA  
ORDER ENTRY: 800/323-3779 • FAX: 800/237-6435

### JABRO Batteries S.W., Inc.

25700 I-45 North, #111, Spring, TX 77386  
Phone: 713/367-9393 • FAX: 713/292-7139  
ORDER ENTRY: 800/245-1138

Canadian Affiliate: 403/248-4020 • European Representative: (33)-1 43.00.94.94

Circle (49) on Fast Fact Card

*...the local repeater receiver signal is folded back to the local transmitter through the attenuator pads...*

one rack unit provide all the required equipment for the four-wire balanced audio signaling and allow all the levels to be set correctly.

Figure 6 on page 57 shows a typical audio path around the system, where the audio is being received from the repeater receiver on the midway site. The audio initially is fed back via the splitter through an attenuator into the local repeater transmitter so other mobiles in the local area can monitor the call.

Two additional ports on this splitter pass audio to the linking equipment,



# R2600



All that test equipment you've been using, with its endless cabling and "we mean business" knobs and switches, has served you well over the years. But someday you're going to need to replace it. That someday is today!

Digital testing is a reality; Cellular testing is big business; Software-driven testing is the future, and it's all available now in one box... the R2600 from Motorola.

#### The R2600 can provide:

- 1GHz Signal Generator
- Sweep Generator
- Duplex Offset Generator
- AC/DC Voltmeter
- Sensitive Off-the-Air Receiver
- Audio Generators
- AF & RF Counters
- Full Screen Spectrum Analyzer with Audio
- SINAD & Distortion Meters
- Terminated Wattmeter
- Signalling Simulator & Decoder
- Signal Strength Meter
- Full Screen Digital Oscilloscope
- 50 MHz Tracking Generator Option
- Cable Fault Option
- Subscriber Unit & Cellular Base Station Test Options

**The R2600 features:** 30 Test Set-Up Memories; Built-in Self Calibration; RS-232 Remote Control; Operator Selectable Special Functions; Help Screens; and a Color Monitor Port. Easy to use, easy to setup, transportable, intuitive to operate, economical, and upgradeable.

Call **1-800-235-9590**

or call (602) 441-8676, or write:  
P.O. Box 2606 - M/D H3170 - Scottsdale, AZ 85252

™ MOTOROLA is a trademark of Motorola Inc.  
© Copyright 1992 Motorola Inc.

Circle (67) on Fast Fact Card



**MOTOROLA**



both downstream and upstream to the other sites, where the appropriate area repeater transmitters repeat the mobile's call. The signal stops at these end sites and is not folded back down the link again.

One other item is shown in Figure 6 and in Figure 4, as well. There are additional ports on the splitter and combiners that serve either as test points (for level measurements, for example) or for attachment to other equipment, such as local site telemetry or status monitoring equipment.

Timing with speech and data signals over this full-duplex link is less of a problem, assuming the link operates permanently. In this case, because the links are established, the only delays in the network are from the repeater equipment.

For the example previously described, the end-to-end delay is reduced from 300mS to 80mS, which is barely noticeable. Even with CTCSS in the system, the link delay extends only to about

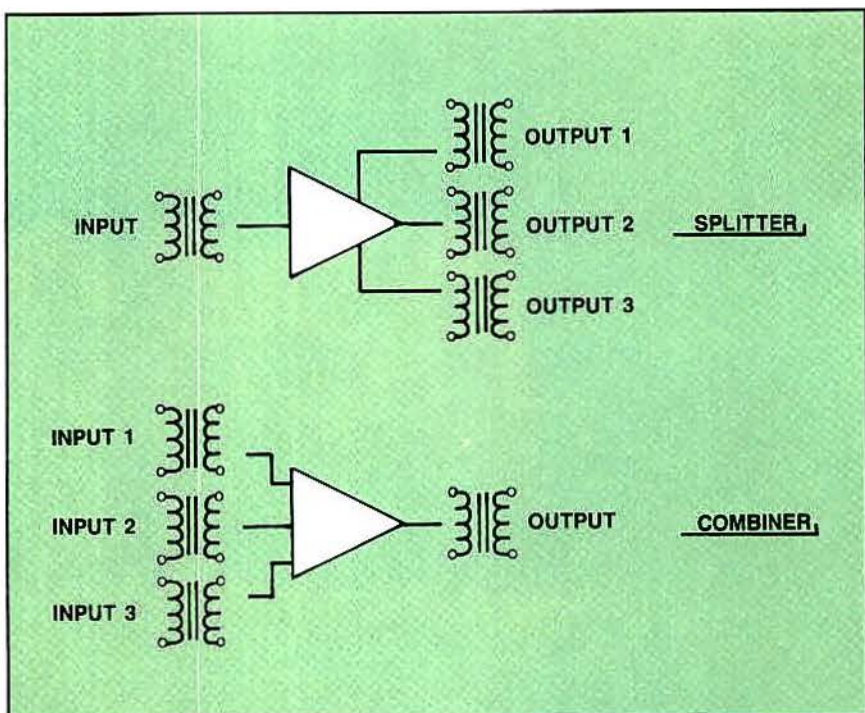
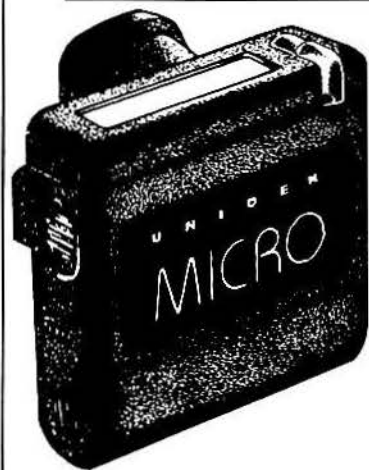


Figure 5. An active splitter-combiner can be quite complex, especially for sites such as Figure 4's midway site where fully balanced 600 $\Omega$  inter-unit audio is used.

## uniden NUMERIC



- VHF, UHF, 900 mhz
- POCSAG Signalling Format
- Holds up to 16 messages
- 128 Character memory
- Selective message delete
- Uses one "AA" alkaline battery

**VCP** COMMUNICATIONS DIVISION

P.O. Box 550999 • Dallas, TX 75355-0999  
Toll Free 1-800-527-9366 • Fax (214) 278-5981

Circle (51) on Fast Fact Card

## Solar/Cell Batteries



**For all your remote power needs:**



**SOLAR ELECTRIC  
SPECIALTIES CO.**  
P.O. Box 537 Willits, CA 95490

**Order Hotline 800-344-2003**

Circle (52) on Fast Fact Card



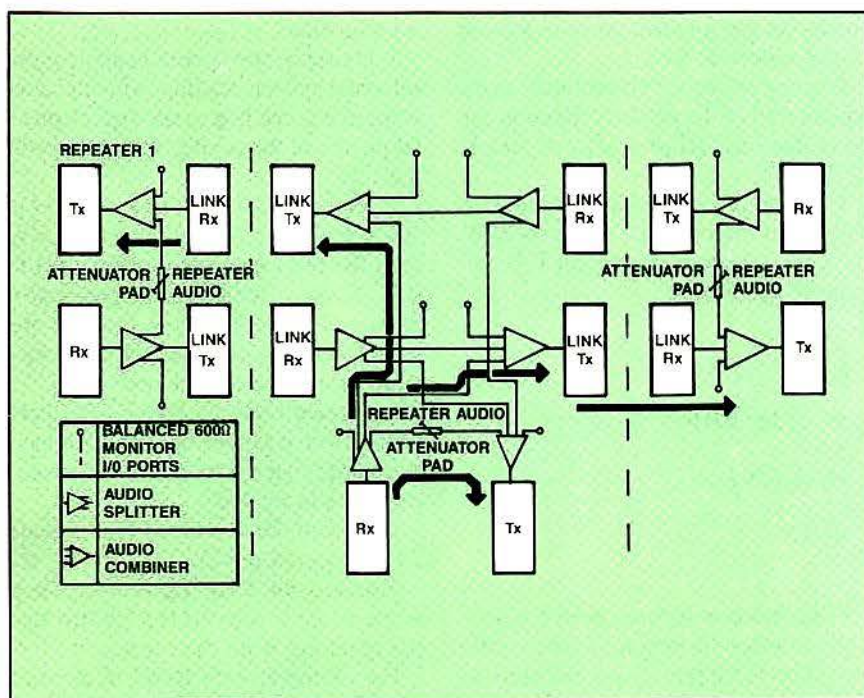


Figure 6. A typical audio path around the system initially feeds audio received from the repeater receiver on the midway site back via the splitter through an attenuator into the local repeater transmitter so other mobiles in the local area can monitor the call.

170mS, about half the delay of the simple half-duplex system.

These timing advantages become even greater in view of more realistic applications, such as systems for larger statewide or nationwide radio networks, in which five or more links may be used.

When it comes time to purchase or to design a new linked mobile radio system, these descriptions of half-duplex and full-duplex linking methods may provide a useful starting point for decision-making.

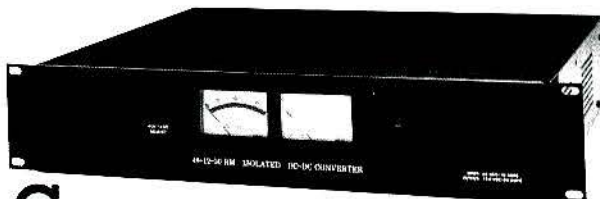
Points that normally are taken into consideration include speech and data applications and the use of CTCSS. Linking delays have a bearing on the use of half-duplex vs. full-duplex networks for specific applications.

#### Additional reading

Woodfield, A.O.J., "Using SINAD Voting Combiners in Mobile Radio Networks," *Mobile Radio Technology*, April 1993.



**When The Spec Calls For Excellent Voltage Regulation, Low Noise, And High Efficiency, Call NEWMAR.**



**C**ommunication sites require isolated DC-converters to provide excellent voltage regulation, low noise, and high efficiency. Reliability is vital under continuous duty operation and high ambient temperatures. All these aspects were incorporated in the design of NEWMAR'S rackmount DC-converters.

These units accept 48 VDC positive or negative input and produce pure 12 or 24 volt power. The solid state circuitry is conservatively designed and semi-conductors are selected and tested to withstand 100% more power than required during normal operation.

**NEWMAR**

RELIABILITY BEYOND COMPARE  
Phone: (800) 854-3906 • FAX: (714) 957-1621

Circle (53) on Fast Fact Card

# Hold On To Your Money!

**Panasonic Numeric**  
VHF, UHF, 900  
MHZ Numeric  
Display Pager



**WHY** tie up your capital resources in excessive inventory?  
Buy one or 1,000. With no minimum order, VCP lets you buy only the stock you need. And our same day shipping\* gets it to your shelves fast!

VCP stocks pagers, parts, refurbishing kits and batteries.  
Terms: Net 30, C.O.D., company check or cash

\*On in-stock items ordered by 12 noon CST

**VCP** COMMUNICATIONS DIVISION

P.O. Box 550999 • Dallas, TX 75355-0999  
Toll-Free 1-800-527-9366 • Fax (214) 278-5981

Circle (54) on Fast Fact Card



## Technically speaking

(continued from page 8)

10dB, then the return loss at the antenna is:

$$\begin{aligned} R_L &= 2(L_L) \\ &= 10 - 2(2) \\ &= 6\text{dB} \end{aligned}$$

where

$R_L$  = return loss in decibels at the transmitter

$L_L$  = transmission line loss

It is necessary to multiply the line loss by a factor of 2 because both the forward power and the reflected power are attenuated by the line loss. In this example, the forward power is 2dB lower at the antenna, and the reflected power is 2dB higher at the antenna.

► **Reflection coefficient**—Simply stated, reflection coefficient is the ratio of

voltage of the incident wave to voltage of the reflected wave.

Because voltage is proportional to the square root of the power, reflection can be defined as  $\sqrt{(P_R/P_F)}$  or simply  $\sqrt{(P_R/P_F)}$ .

For example, if the forward power is 100W and the reflected power is 25W, then the reflection coefficient  $\Gamma$  is calculated as follows:

$$\begin{aligned} \Gamma &= \sqrt{(25/100)} \\ &= \sqrt{(0.25)} \\ &= 0.5 \end{aligned}$$

► **Reflected-to-forward power ratio**—The reflected-to-forward power ratio unit of measure probably is the most familiar to land mobile radio technicians because they favor the use of an in-line directional wattmeter to measure forward and reflected power on the trans-

mission line.

It is simple, then, just to compare the reflected power reading with the forward power reading to get a quick mental picture of the degree of mismatch on the line.


For example, if the forward power is 100W and the reflected power is 25W, then the ratio (reflected-to-forward) is 0.25. Notice that this figure is the *square of the reflection coefficient* that was obtained using the same reflected and forward power measurements.

► **Percent reflected power**—The percent reflected power figure is obtained by multiplying the reflected-to-forward power ratio by 100.


For example, a ratio of 0.25 equals 25% reflected power.

**Transmission loss**—Transmission loss is the actual loss in the transmitted signal resulting from the mismatch.

For example, with 100W of forward power at the antenna and 25W of reflected power, only 75% of the *available power* is transmitted. The transmission loss is:



# MDS MOBILE



## GE WHOLESALE DISTRIBUTION CENTER

<b>TLH22</b>	<b>MDS 150-174 MHZ 40W, 2 CH.....</b>	<b>\$600</b>
<b>TLH28</b>	<b>MDS 150-174 MHZ 40W, 8 CH.....</b>	<b>\$675</b>
<b>TLU22</b>	<b>MDS 440-470 MHZ 40W, 2 CH.....</b>	<b>\$700</b>
<b>TLU28</b>	<b>MDS 440-470 MHZ 40W, 8 CH.....</b>	<b>\$775</b>

- ◆ LED Display of Selected Channel
- ◆ Tone and Digital Channel Guard
- ◆ 2 Channel and 8 Channel Models

- ◆ PC Programmable
- ◆ 40 W RF power
- ◆ Data Capable
- ◆ Programmable ANI
- ◆ All Metal Frame

**COMPARES TO...**  
Johnson Challenger Plus  
Motorola Maxtrac

1-800-336-6825 • Fax 219-483-5584

Circle (55) on Fast Fact Card

# CABLE SETS

## •HIGH QUALITY •FAST DELIVERY •BEST PRICES

Call your local distributor

THE ANTENNA FARM  
CANCOM COMPONENTS  
CMC DISTRIBUTING  
COMMUNICATIONS ASSOCIATES  
COMMUNICATIONS WORKS  
EASTCOM INDUSTRIES  
ECONOMY TWO-WAY DIST.  
ELECTRO-COMM  
GRAHAM RADIO  
HENRY RADIO  
HUTTON COMMUNICATIONS  
JAN INDUSTRIAL  
PRIMUS ELECTRONICS  
RF SERVICES  
SANTA FE DISTRIBUTING  
TALLEY ELECTRONICS  
TECHNICAL EQUIPMENT DIST.  
TESSCO INC.



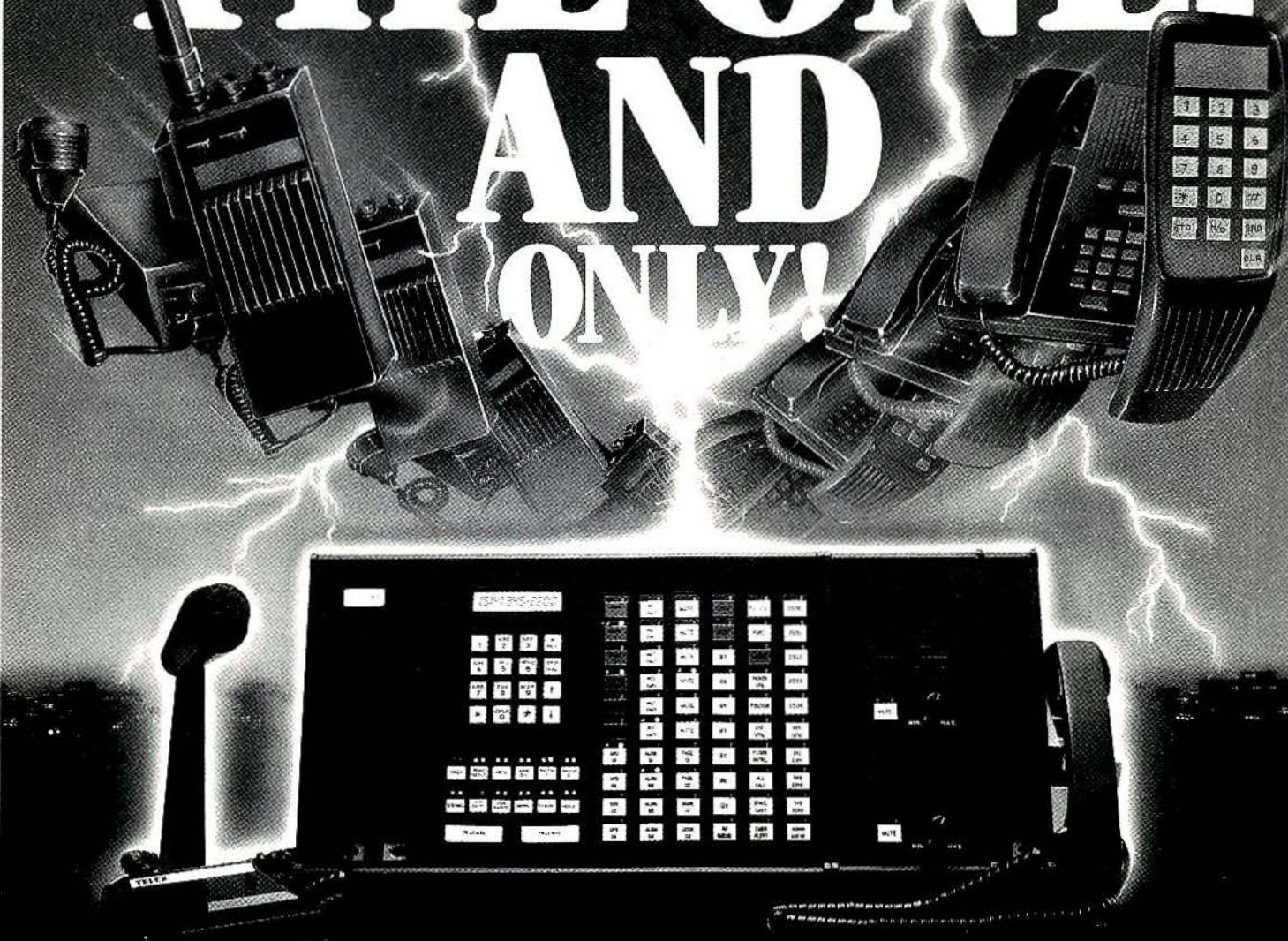
## cushcraft/Signals

48 PERIMETER ROAD • MANCHESTER, NH 03106 USA  
TEL: 603-627-7877 • FAX: 603-627-1764 • TELEX: 4949472  
**800-258-3860 • FAX: 800-258-3868**

Circle (56) on Fast Fact Card



# THE ONE. AND ONLY!



## THE SYSTEM THAT FULLY INTEGRATES TELEPHONE AND RADIO IN ONE COMPACT CONSOLE!

POSITRON has the system that combines radio and telephone into one compact and versatile unit! It also integrates paging and call identification like no other system does!

### ☐ Quicker, easier to use!

POSITRON re-defines "user friendly"! You enjoy faster access to features, because everything's at your fingertips, in one easy-to-operate unit!

### ☐ More compact!

You get big-league performance with a small foot-print... everything you need, yet it takes up so little space.

### ☐ Highly versatile!

Completely software programmable, POSITRON lets you easily configure your system to your particular requirements such as: • Queue 1 to 4 • Instant transmit • Speed dial • Take over dispatcher • Ring select. It is compatible with your current equipment and easily expandable to meet all your needs.

### ☐ Highly reliable!

This POSITRON system was developed together with emergency services systems users thus ensuring the highest possible level of reliability.

### ☐ E 9-1-1

Suppliers of E 9-1-1 Emergency systems and products.

For further information, write or call:



## POSITRON

*Where Communication Technologies Meet*

**Positron Industries Inc.**  
5101 Buchan Street  
Montreal, Quebec, Canada H4P 2R9

# (514) 345-2200

Head Office: Montreal    Offices: New York, Chicago, Los Angeles, Toronto

Circle (57) on Fast Fact Card

CALL (800) 443-3313



## Technically speaking

$T_L$

$$\begin{aligned} &= 10 \log(1 - r) \\ &= 10 \log(1 - 0.25) \\ &= 10 \log(0.75) \\ &= 10 \times -0.125 \\ &= -1.25 \text{ dB} \end{aligned}$$

**Conversion formulae:** The following formulae can be used to convert between any of the measuring units discussed.

$$S = \frac{1 + \sqrt{r}}{1 - \sqrt{r}}$$

$$S = \frac{1 + \Gamma}{1 - \Gamma}$$

$$S = \frac{1 + 10^{-(R_L/20)}}{1 - 10^{-(R_L/20)}}$$

$$r = \left( \frac{S-1}{S+1} \right)^2$$

$$r = \Gamma^2$$

$$r = 10^{-(R_L/10)}$$

$$\Gamma = \sqrt{r}$$

$$\Gamma = \frac{S-1}{S+1}$$

$$\Gamma = 10^{-(R_L/20)}$$

$$R_L = 10 \log \left[ \left( \frac{S-1}{S+1} \right)^2 \right]$$

$$R_L = 10 \log \left( \frac{1}{r} \right)$$

$$R_L = 10 \log \left( \frac{1}{\Gamma^2} \right)$$

$$T_L = 10 \log \left[ 1 - \left( \frac{S-1}{S+1} \right)^2 \right]$$

$$T_L = 10 \log(1 - \Gamma^2)$$

$$T_L = 10 \log(1 - r)$$

$$R = 100r$$

where

$S$  = VSWR

$\Gamma$  = reflection coefficient

$T_L$  = transmission loss in decibels

$R_L$  = return loss in decibels

$r$  = reflected-to-forward power ratio

$R$  = percent reflected power

**Nomograph**—The nomograph in Figure 1 on page 8 converts between equivalent units of VSWR, return loss, percent reflected power, reflection coefficient and transmission loss that lie on the same line. At a glance, you can convert from any unit of measure to another.

There are a few advantages that are not so apparent at first glance.

For example, if you know the VSWR at the transmitter and the line loss, you can find the VSWR at the antenna by

using the following example as a guide.

The VSWR at the transmitter is 2.0:1, and the line loss is 2.5dB. Locate 2.0 on the VSWR scale and read the equivalent return loss in decibels on the next scale. It is approximately 9.5dB.

Subtract twice the line loss ( $2 \times 2.5 = 5$ ) from the return loss reading, and move to that point on the return loss scale. This point will be 4.5dB on the return loss scale, which is equivalent to a VSWR of approximately 4:1 at the antenna.

The nomograph can be used to determine the maximum VSWR that can be seen at the transmitter for a given amount of line loss.

For example, suppose the line loss is 3.0dB. Double this figure and move to 6 on the return loss scale. Follow the line out to the VSWR scale, and note that for a 3dB line loss, the maximum VSWR seen at the transmitter is approximately 3.0:1.

The *transmission loss* scale may provide some surprises.

For example, notice that for a VSWR of 3.0:1, the transmission loss is only 1.25dB. It appears, then, that a VSWR of 3.0:1 is not so terrible after all.

Here is the catch: Modern radio transmitters have an automatic power reduction circuit that limits output when a high VSWR is detected. Thus, the practical transmission loss would be much greater for such radios than would be indicated by the nomograph.

For example, if power output is reduced 50% for a VSWR of 3.0:1, this reduction would add 3dB to the *normal* transmission loss to make the practical effect a net 4.25dB transmission loss.



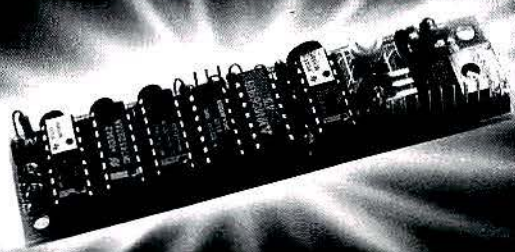
## Securitron Model 813A

Now there is a compact, affordable Morse code identifier that's perfect for Common Carrier, Maritime, Aviation, Land and Amateur radio identification. Introducing the Securitron Model 813A. The Model 813A features multi-mode operation, field replaceable memory, adjustable audio and programmable code speed, tone and repeat interval ... all in a rugged miniaturized design. For complete details on the Model 813A, contact Securitron today.

**(408) 263-6434**

Securitron Company • P.O. Box 32145, San Jose, California 95152

**Radio  
Station  
Identifier**



Circle (58) on Fast Fact Card



## Publicity campaign, views of future highlight Mobile Communications Marketplace

San Francisco was the site for the Mobile Communications Marketplace trade show Sept. 21-25. The show is sponsored by Telocator, a Washington, DC-based trade association whose constituents include radiopaging system operators and members who want to offer future personal communications services (PCS).

The audience for the opening session saw excerpts of TV interviews and newspaper coverage generated by the association's yearlong campaign to highlight positive aspects of pager use. The coverage helped to offset adverse publicity the paging industry received in 1991 in stories about illegal drug traffickers' use of pagers.

In a campaign underwritten by Motorola, Schaumburg, IL, Telocator made a spokesperson available for TV interviews and sent information packages to newspapers. The spokesperson, Michael Fortino of San Francisco-based Fortino & Associates, a management training and consulting firm, appeared on many TV stations' news and talk programs. Newspapers printed stories about how pagers help busy people manage time and stress.

Some stories explained how pagers help parents and children call one another for meals and rides. Other stories explained how pagers help parents to call children home from play and help children let working parents know they have arrived home from school.

The campaign was carried out under the banner of the Paging Services Council, a consumer information source operated by Telocator.

### Hollywood connection

In addition, Telocator placed advertising in entertainment industry trade publications to offer pagers for use as props in TV and movie productions. Pagers have been made available to key writers and producers to familiar-

ize them with their applications. Contacts were made with screenwriters to encourage them to write positive applications for pagers into their TV and movie scripts.

Now that the initial year of Motorola's sponsorship has ended, the association plans to fund the publicity campaign.

Telocator president Thomas Stroup told the audience the association would like to see private and common carrier paging governed by a common set of rules. Another association goal is for paging licenses to be issued for service to an area, not by transmitter site, emulating the method for cellular mobile telephone system licensing.

### Association goals

New Telocator chairman William de Kay of Dial Page, Greenville, SC, outlined his goals for the association in the coming year. He said the goals are based on leveraging the association's past successes:

1) to keep Telocator strong by providing a value worth the members' dues and maintaining the association's financial strength.

2) to help the industry to grow by continuing the publicity campaign for paging and by supporting members' and manufacturers' developments in narrowband and wideband personal communications services.

3) by building on a positive relationship with the FCC.

Telocator and the Cellular Telecommunications Industry Association

(CTIA) are cooperating in a project to rewrite Part 22 of the FCC rules that regulate common carrier mobile services. At one time, the two associations competed for cellular carrier members, and cooperation between them was difficult to achieve.

Indicating the new level of cooperation, CTIA president Thomas Wheeler participated in the trade show's session on the mobile communications industry's future.

### Views of the future

Seven panelists exchanged opinions and answered questions from Stroup, who was the moderator, and from audience members.

George Perrin, president of Paging Network, said the \$10/mo. paging customer will continue to offer opportunities for paging companies. "Companies will be able to use their infrastructure and back office to take advantage of other communications service opportunities, too," he said.

Alan Reiter, group executive editor of *Mobile Data Report* newsletter, foresaw the demise of high-end paging services. He said they will give way to palmtop computers with built-in pagers.

Brian Pemberton, president of American Mobile Satellite, said: "I foresee pervasive North American coverage for cellular carriers and SMRs and, by 2000, worldwide compatibility among mobile communications services." (SMRs are specialized mobile radio systems that offer two-way radio and mobile telephone service.)

David Garrison, president of Skytel, said that equipment cannot be offered at the lowest prices that will allow the greatest mar-



**Telocator president Thomas Stroup moderates a panel session about wireless communications in 2000.**



**Telocator chairman William de Kay lists goals for 1993.**



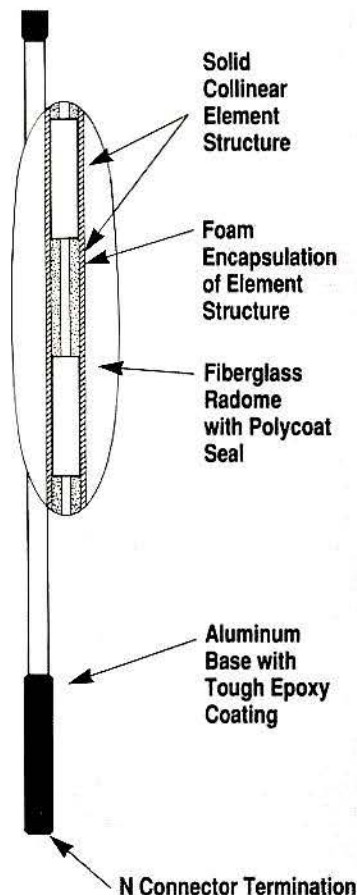
**Fleet Call chairman Morgan O'Brien shuns regulatory protection.**



## Don't Be Fooled!

*You don't have to pay a premium price for a premium antenna.*

## BSXL Series Base Antennas



## Compare with the Best!

Many look alike antennas appear to be equal, but are simply constructed with a radome covering an end fed wire.

We invite you to compare our price and performance!

**Call For Free Product Data Book**

**1-800-634-4622** Fax (708) 790-9799  
Quality Products Made in the USA since 1978  
**Comtelco Industries, Inc.**  
501 Mitchell Rd., Glendale Hts., Illinois 60139

Circle (59) on Fast Fact Card

## News

ket penetration until worldwide standards are adopted.

Morgan O'Brien, chairman of Fleet Call, said: "I see dinosaurs roaming the landscape, stepping on themselves and each other," referring to mobile services companies that rely on regulators to protect them from competition. "We [Fleet Call] don't want regulatory protection. It may help in the short run, but it becomes an anchor to be dragged around forever."

O'Brien identified the trend as a continuing obliteration of distinctions among mobile services businesses.

### Paging regulation

Speaking to a luncheon audience, FCC commissioner Sherrie Marshall gave operators of large paging systems good news: "The commission has no intention of withholding a decision on



**FCC commissioner Sherrie Marshall gives good news to operators of large paging systems.**

the 900MHz narrowband allocation until all the other issues related to broadband PCS are resolved," she said.

"Most of the commissioners, including myself, incorporated the 900MHz allocation in the general PCS docket

with the clear understanding that the narrowband issue will proceed on a separate track, if necessary," the commissioner said.

The next Mobile Communications Marketplace is scheduled for Sept. 28-Oct. 1 at the New Orleans Convention Center in New Orleans.

## Allied-Signal to divest mobile communications unit

Allied-Signal, Torrance, CA, has decided to sell its Mobile Communications division in Lawrence, KS.

In making the announcement, Allied-Signal said that the Bendix/King Mobile Communications division is a strong, profitable business with substantial growth potential. The company said that it decided to divest the division after a thorough review of the strategic outlook of its core businesses.

Allied-Signal said that it will focus its management and financial resources on its core aerospace businesses.

The investment banking firm of Morgan Stanley, New York, has been retained to market the business unit.

With 1992 revenues of approximately \$36 million, the division designs, manufactures, distributes and supports two-way radio products for the ground communications market.

## Repeco files for protection from landlord, creditors

Repeco, an Orlando, FL-based manufacturer of two-way radios and RF modems, has petitioned the federal court for protection from creditors under Chapter 11 of the Bankruptcy Act.

According to Repeco vice president Joanne Kostantinidis, the company was burdened by a headquarters and manufacturing facility several times larger than necessary for current operations. Its landlord would not renegotiate the remaining 15 years of a 25-year lease to the company's satisfaction, so it relocated and asked the court for protection.

Repeco sells its products to Aerotron-Repeco Sales (ARS), which in turn resells them. The current product line

includes crystal-controlled lowband VHF and highband VHF hand-held two-way radios and modems for sending data and telemetry over radio channels.

"Aerotron" in Aerotron-Repeco Sales' name refers to Raleigh, NC-based radio equipment manufacturer AER-Aerotron. ARS, Repeco and AER-Aerotron are related companies inasmuch as they are controlled through majority stock positions owned by Atlas Financial Holdings, headed by Andrew Kostantinidis, Joanne Kostantinidis' father.

Repeco and ARS are at 2400 Sand Lake Road, Orlando, FL 32809; telephone 407-856-1953.





## SMR operators file multiple license applications

By Alan S. Tilles, Esq.

The surge of 800MHz wide-area digital specialized mobile radio (SMR) system applications filed with the FCC continues.

Additional applications have been filed by CenCall for Kansas, Missouri and Oklahoma, in addition to the company's earlier Colorado filing. U.S. Digital has applied to add sites to its earlier Florida application. Johnson Communications has filed applications for Atlanta; Advanced MobileComm for Las Vegas; and Questar for Seattle and Portland, OR.

The new filings come on the heels of an FCC Private Radio Bureau order freezing all additional "short-spacing" not based upon the commission's Part 90 short-spacing chart. The freeze, originally requested by Motorola, is intended to continue until the agency completes a rulemaking that would review standards for granting short-spacing waivers.

There is a consensus within the SMR industry that any short-spacing minimally should meet the 40dBμ/22dBμ desired-to-undesired signal overlap analysis originally suggested by the National Association of Business and Educational Radio (NABER) and the American Mobile Telecommunications Association (AMTA).

Nonetheless, industry participants have expressed concern that some of the wide-area filings have cited a 40dBμ/30dBμ overlap analysis. It is unclear whether the FCC will grant the waivers requested on the basis of the 40dBμ/30dBμ overlap analysis. Still, the commission clearly is troubled by the wide-area waiver requests that seek to expand service footprints into areas not currently served.

The numerous filings have caused many SMR operators to re-evaluate their business plans. The changing SMR landscape has accelerated some plans, changed others and appears to be attracting the interests of larger

players. The resulting shape of the SMR business remains to be seen.

### License gap

Apparently, word that the FCC eliminated SMR end-user licensing did not reach the agency's field office employees as quickly as it reached SMR system operators.

Shortly after the new rules eliminating the licensing requirement became effective, FCC Field Operations Bureau employees in at least two offices approached SMR end-users and requested copies of their licenses. When the SMR system operators involved found out, they contacted the FCC's Washington headquarters and asked that the field offices be notified that end-user licenses are not required.

### SMR licensing scams

Several business entities have been marketing a so-called third cellular license opportunity to the general public, even through broadcast radio commercial announcements.

The marketers describe the SMR business in terms that in some cases mislead anyone unfamiliar with the business. For example, in one case, statements lead the unwary applicant to believe that the FCC currently is accepting applications for 900MHz SMR systems. Other statements incorrectly indicate that the application is *guaranteed* a license for a location somewhere in the United States.

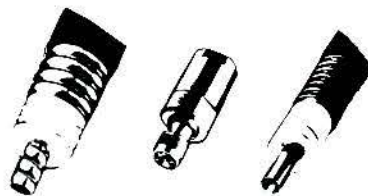
The FCC has reacted to these misleading presentations by issuing a consumer alert. The alert seeks to correct the following *misimpressions*:

- (1) The SMR service is a recent development.
- (2) SMR licenses are cellular mobile telephone licenses.
- (3) The FCC currently is accepting 900MHz SMR applications.
- (4) The 800MHz SMR frequencies are readily available in large urban areas.
- (5) An SMR license for an unconstructed system may be sold.
- (6) There is a fee for obtaining a copy of FCC Form 574.

Tilles, MRT's regulatory consultant, is a partner in the law firm of Meyer, Faller, Weisman and Rosenberg, P.C., Washington, DC.



## SANTA FE distributing FOR ALL YOUR CELWAVE PRODUCTS



**CELLFLEX®** Closed cell foam dielectric with low density & high velocity

**AVAILABLE IN**  
1/2"      7/8"      1 5/8"

**LLFLEX®** Foam - stranded inner conductor, excellent flexibility, low loss

**AVAILABLE IN 1/2"**

**SANTA FE CAN  
CUT TO LENGTH &  
INSTALL CONNECTORS  
REELS or BOXES**

**FULL LINE OF  
CELWAVE **

**BASE ANTENNAS  
MOBILE ANTENNAS  
DUPLEXERS**

**SANTA FE distributing  
800-255-6595**

**14400 West 97th Terrace**

**Lenexa, Kansas 66215**

**913-492-8288 Local**

**913-894-2136 Fax**

**WE CAN FILL YOUR  
NEEDS WHETHER  
LARGE OR SMALL**



## Readers' choice

Of all the new products and services in the May 1992 issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

### Portable handles voice encryption

Model M-PA Voice Guard portable radio from **Ericsson GE Mobile Communications** suits conventional uses and GE's digital access communication system (DACS). The hand-held with voice encryption comes in select, scan or systems models. The radio is available in VHF and UHF bands in the conventional version and in both UHF and 800MHz bands in the DACS dual-mode versions.

Circle (500) on Fast Fact Card

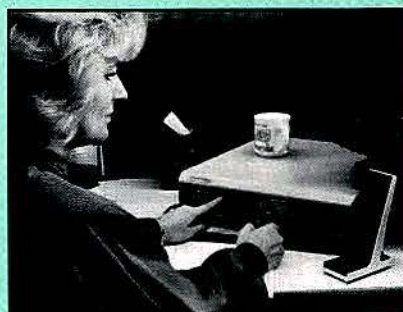
### VHF, UHF portables provide 5W output



The SH505FDT VHF portable and model SH405FDT UHF portable come with a 600mAh battery and offer 5W RF output. The synthesized portables include CTCSS, power save function, keyboard light and keyboard lock. Channel capacity is 10 to 60, and the portables are available from **Shinwa Communications of America**.

Circle (501) on Fast Fact Card

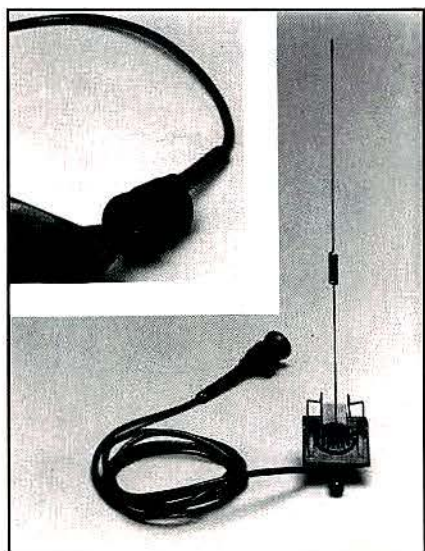
### Programmable desktop station delivers 128 channels



The Spectra field-programmable desktop station from **Motorola** includes 128 channels for use in allotted frequencies in VHF, UHF, 800MHz and 900MHz bands. The unit features call alert and private conversation functions. Trunked versions can access 240 talk groups and multiple conventional channels.

Circle (502) on Fast Fact Card

### Clip-on antenna to improve vehicular hand-held reception



The clip-on coupler antenna from **Mobile Mark** works with the Motorola Micro T A C cellular hand-held for better in-vehicle performance. The antenna slides on and off a vehicle door's window, and the whip is outside the car for better reception.

Circle (300) on Fast Fact Card

### GPS-based location sensor locates vehicles

Placer GPS 300 is a GPS-based location sensor that is specifically designed for vehicle applications. The 6-channel receiver/antenna installs on the top of the vehicle and measures 4.5" x 6.4" x 1.6". The unit from **Trimble Navigation** reports reliable positions in less than 30 seconds and can reacquire vehicle positions in 3 seconds when GPS satellite signals are temporarily blocked by tall buildings.



Circle (309) on Fast Fact Card

### Wireless mobile systems connect mobile workforces

The DataTAC system from **Motorola** extends information systems and networking resources to mobile workforces in the field. It includes intelligent and rugged user devices, a set of high-message throughput infrastructure products, and a core radio data technology that delivers higher data traffic volumes over land mobile radio channels than currently available systems. DataTAC supports traditional mobile applications such as computer-aided dispatch, database inquiry and vehicle fleet management; and provides for future applications

for enhanced report writing, E-mail, graphics and imaging. Most DataTAC products support the radio channel protocols of installed systems, allowing new products to be introduced to these systems over a period of time.

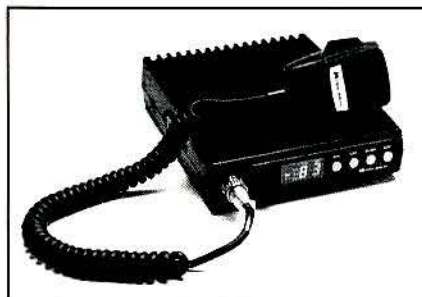
Components include intelligent mobile terminals and workstations, portable terminals and computers, mobile radio modems, pen-based computers, portable radio modems with built-in two-way paging and data communications network products for interfaces to host applications.

Circle (325) on Fast Fact Card



### Trunked radio works with LTR-compatible units

Model 70-9020 two-way FM mobile radio is compatible with any 800MHz trunked system using the LTR protocol. The 15W under-dash mobiles can be programmed for up to 10 systems, trunked or conventional in any combination. The **Midland** mobile is programmable for two trunked priority call levels and for transpond, which automatically acknowledges in-range trunked units to the caller.



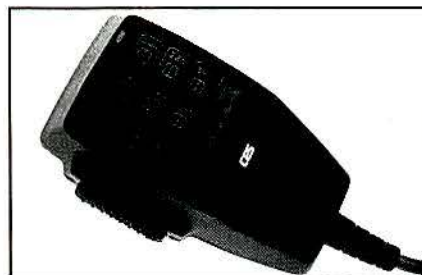
Circle (314) on Fast Fact Card

### Computer program anticipates antenna pattern distortion

The Antenna Pattern Module of the Terrain Analysis Package is a computer program that predicts what happens to the antenna pattern depending on the mounting orientation on the tower, the distance from the tower face or leg, tower face dimension, tower shape, antenna gain and transmitted frequency. The program from **SoftWright** calculates, tabulates and plots the anticipated antenna pattern with the particular mounting information proposed.

Circle (318) on Fast Fact Card

### Mic offers DTMF encoding



CES' heavy-duty manual dialing DTMF encoding microphone features a backlit, tactile alphanumeric keypad. Model 805 is the manual hardened version of the 810 sealed programmable microphone and is designed to meet MIL-STD-810 for shock, vibration, temperature extremes and rain.

Circle (305) on Fast Fact Card

### Radio tower monitoring system implements nationwide service

**LODA (Location Data Systems)** is implementing a nationwide radio tower monitoring system. The R-2000FS monitors events at remote radio tower sites and reports alarms and malfunctions on an around-the-clock basis to LODA Central. Within minutes of a tower light failure, an alarm is transmitted to LODA Central, which

makes prompt notification to the appropriate FAA Flight Service Station and the tower's customer. Features include a complete back-up light controller, internal verification of photocell operation, FalseSafe confirmation of alarms, confirmation of proper flash rates and sequencing, and battery back-up.

Circle (321) on Fast Fact Card

## If you ever DF from 25 to 1000 MHz and need to do it unobtrusively, you'll want the TD-L8630P-II



### *Hardly anyone will notice.*

This compact unit from Simrad/Taiyo provides radio direction finding capabilities on all frequencies from 25 to 1000 MHz (also 1.6 to 25 MHz with optional antenna). Easily portable, the unit comes with a camera bag sized case with shoulder strap. The unit also operates as a monitor receiver from 100 kHz to 2 GHz. A hand-held antenna with pistol grip is supplied standard, or

for covert operation a special flat antenna is mounted directly on the main unit. Bearing is indicated by a circular LED display and a meter shows field strength. Spare rechargeable battery,

charger and carrying case are included. Police, defense, security, and other intelligence operators no longer have to worry about jammed communications. If you need to locate interference or other RF source, the 8630P-II is the tool for you. And hardly anyone will notice. Send for complete information today, or call toll-free 1-800-426-5565. **Simrad. A name you can trust.**



**SIMRAD, Inc.**  
19210 33rd Avenue West  
Lynnwood, WA 98036  
Telephone: (206) 778-8821  
Toll-free: (800) 426-5565



**SIMRAD**



Circle (50) on Fast Fact Card



## New products

### Radio fits in shirt pocket

Available in UHF and VHF, model HX241 is a 16-channel radio that is compact enough to fit in a shirt pocket. The radio from **Standard Communications** is equipped with CTCSS tones, DCS codes, power output of 1.5W or 4W and an LCD readout with an operator selectable scan function.



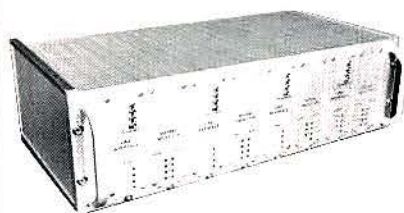
Circle (315) on Fast Fact Card

### Software offers site plotting, composite coverage prediction

MSITE version 1.0 offers comprehensive composite coverage prediction and plotting for multiple antenna sites or facilities. The software offered by **EDX Engineering** plots composite maps (for as many as 16 sites), shadow, field strength, receive power level, interference or signal ratio, and most likely server.

Circle (311) on Fast Fact Card

## SIGNAL-TO-NOISE Voting Comparator



Improve coverage by adding receivers

- Expandable to 32 Channels
- Continuous Voting
- 19" Rack Mountable
- Select/Disable Switches for Manual Override
- Can be used with RF Links or Dedicated Lines
- LED Indicators
- Hundreds in Service
- More

— **Competitively Priced** —

For more information call or write:

**Doug Hall Electronics**  
Voter Dept.  
815 E. Hudson St.  
Columbus, Ohio 43211  
(614) 261-8871

Circle (62) on Fast Fact Card

### Software applications include satellite, microwave comms

The **EEsof** Series IV software is a new generation of Unix-based electronic design automation (EDA) for high-frequency analog circuit and system design. The software incorporates X-Windows and Motif graphical user interface. Applications include the design of cellular and personal communications (PCN) system, satellite and microwave communications, high-speed computer interfaces, and radar and electronic defense systems.

Circle (313) on Fast Fact Card

### Miniature encoder offers 15 paging codes

The PE-15 is a miniature sub-assembly encoder capable of sending 15 separate codes in the POCSAG (RPC-1) format. The PE-15 is intended for operators of local "in-house" radio systems wishing to signal tone-only pagers. The 15 available codes may be used to activate as many as four distinct alert tones on each pager, 15 individual pagers or any combination. The paging encoder from **Communications Specialists** is factory programmed to specific address codes or may be field programmed via an available keypad.

Circle (308) on Fast Fact Card

### Connectors turn at 90° angle



T and L adaptors for 7-16 coaxial connectors are available when low intermodulation products are desired or when the routing of the transmission line must turn 90° in a space too small to accommodate normal cable bands. The connectors from **Huber+Suhner** have reflection factors as low as .02 max. at 5.5GHz.

Circle (319) on Fast Fact Card

### Power module converts ac to dc

AC-Plus power module from **CSC Power Systems** converts 110Vac to 12Vdc for two-way radios and other devices operating through a 110V power supply. The module incorporates an internal 7Ah battery with automatic changeover, charging, filtering and regulation.

Circle (303) on Fast Fact Card

### Machining system repairs printed circuit boards



MicroChine is a lightweight, variable-speed miniature machining system designed to repair and modify circuit boards. The handpiece has a non-chalking static-dissipative plastic housing for static-free operation, and its motor provides measured acceleration to selected speeds from 2,500 RPM to 10,000 RPM. The unit from **Pace** meets or exceeds military and civilian safety requirements.

Circle (317) on Fast Fact Card

### Multi-tasking radio test set cuts test times in half

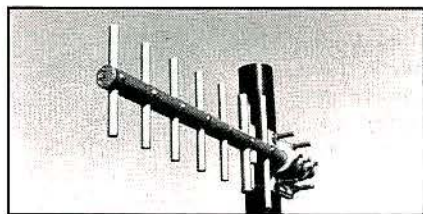
Combining more than 30 high performance instrument functions with fast multiple measurement capability in a compact, lightweight package, the 2965 from **Marconi** is a multi-tasking radio test set. Speed and high accuracy provide fast automated measurements that cut typical radio test times in half. Key RF instrument functions include full-span high dynamic-range spectrum analyzer with tracking generator; accurate RF power meter; storage oscillo-

scope; and fast switching RF signal generator. Audio capabilities include FTT audio analyzer and three independent audio generators. Measurement functions range from a fast sampling 500kHz digital storage oscilloscope (DSO) to a built-in multimeter for measuring resistance, ac/dc voltage, and current. The 2965 internally supports all analog-cellular and trunking standards.

Circle (326) on Fast Fact Card



## Yagi antenna covers trunking, cellular band

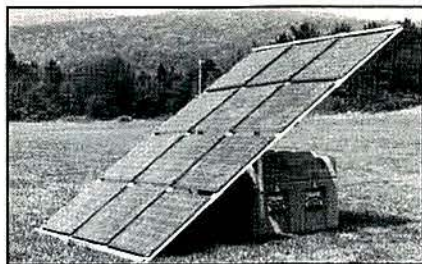


Circle (323) on Fast Fact Card

The TY-840/TY-860 is a seven-element yagi that has 10dBd of gain. The TY-840 covers the broadband range from 806MHz to 869MHz and the TY-860 covers the cellular band from 824MHz to 894MHz. The Scala antennas are anodized and include stainless steel fasteners and u-bolts to prevent corrosion.

## Portable solar generators suit remote locations

The Micro PowerPak series of portable solar electric generators support remote field applications with electric loads from 100W to 2,000W per day. Features include no fuel required, silent operation, low maintenance, low EMI, rapid deployment, compact and portable. The units from Northern Power Systems can power ac and dc applications and are classified by peak solar capacity (72W to 360W).



Circle (304) on Fast Fact Card

## UHF transceiver boasts 5W

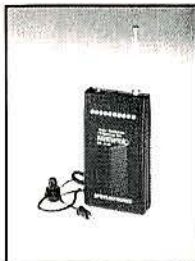
The EasyTalk UHF-50 is a hand-held two-way radio that weighs 16 ounces. The four-channel transceiver comes with a flexible rubber duck antenna with a BNC connector, an ac/dc wall charger, a stainless steel belt clip, carrying case and an 11V NiCd rechargeable battery pack. The radio from Nady Systems operates in the 450MHz-to-470MHz band.



Circle (316) on Fast Fact Card

## Communications device locates stuck transmitters

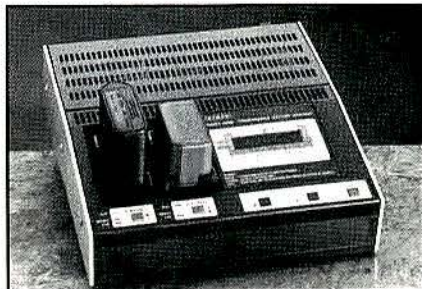
The R20 AM Interceptor checks two-way radios for RF output; makes RF signal strength measurements; locates stuck transmitters; and listens to any AM modulated signal including CB and aircraft two-way transmissions. The ten LED bargraph provides a relative signal level display using 3dB steps for all RF signals detected. The unit from Optoelectronics covers 0.5MHz to 2.5GHz frequencies.



Circle (322) on Fast Fact Card

## Battery analyzer features interface for programming caps, cables

The Cadex C3000 battery analyzer features a menu-driven interface for programming the unit's battery cups and cables. The C3000 services NiCd, nickel metal hydride and lead-acid batteries. Weak batteries are identified and automatically reconditioned; good batteries are exercised to maintain peak performance. With the printer option, battery service reports and labels can be generated; an RS232 port allows interfacing to a computer.



Circle (310) on Fast Fact Card

## Consoles mount equipment together

Four radio control heads, siren and light controllers and scanners are mounted into the face plate adapters that secure into the Command Console. Equipment and cables are secure inside the console, yet accessible for service. The consoles by Troy Products are available for the Chevy Caprice and Ford Crown Victoria. Flat-floor adaptors are available for fire equipment, vans and 4-wheel drive vehicles. The consoles are 11-gallon steel-coated with non-reflective black wrinkle epoxy finish.

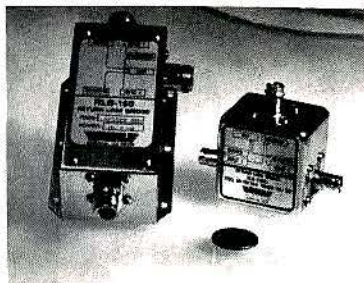


Circle (320) on Fast Fact Card

## SMA connector design fits superflexible cables

The 41ASWS SMA male and 41ASNS SMA female bulkhead connector fit 1/4-inch superflexible cables from Andrew.

Circle (328) on Fast Fact Card



## Return Loss Bridges

RLB150 bridges are a high accuracy low cost solution to SWR measurements. They can be used with spectrum analyzer/tracking generator for swept SWR measurements. EAGLE RLBs have these features:

- Frequencies: .04 Mhz to 1.0 GHz
- RF reflected port
- High Power rating: Five watts
- Rugged construction
- High Directivity: up to 45 dB

Model RLB150B1 .04-150 MHz.....\$259.00  
Model RLB150N3B 5-1000 MHz.....\$349.00

FREE application note: "High Performance VSWR measurements", call and ask for it!

**EAGLE**  
WICHITA

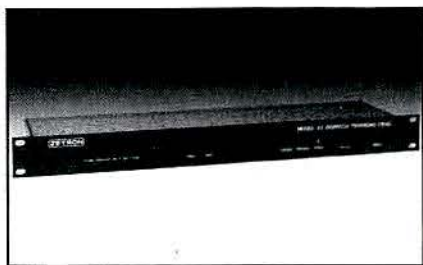
P.O. Box 9446 (316) 942-5100  
Wichita, KS 67277 Fax: (316) 942-5190

Circle (63) on Fast Fact Card



## New products

### Repeater controller boasts smart channel allocation



Circle (324) on Fast Fact Card

The Model 42 converts any digital-capable repeater into a fully featured, dispatch-only LTR trunking channel. It is equipped with a repeater with LTR logic-processing capabilities, subscriber validation, airtime accumulation, automatic program cloning and smart channel allocation. The Zetron unit is intended for dispatch (radio-to-radio) calls, instead of interconnect (radio-to-telephone) calls.

### Communications command center boasts location flexibility

The Swat1000 and Swat2000 suitcase communications command center contains a 110Vac power supply, rechargeable battery and charger. The Teletec unit can switch the duplex in and out of the antenna path, allowing some channels to operate as a repeater, while others operate simplex anywhere in the frequency band. Other features include 1,024 channels in 32 groups of 32 channels; 3 levels of priority scan per group; five operating modes: manual, manual with priority, scan, scan with priority and free channel access; digital or analog encryption option; and phone patch for direct access to



the PSTN using any radio with a DTMF encoder.

Circle (307) on Fast Fact Card

### Dash-mount UHF mobile boasts 114 channels



Circle (261) on Fast Fact Card

The EMV 499 0A UHF mobile from Bendix/King operates from 10W to 40W and is housed in a die-cast frame. The radio includes 114 channels. It may be programmed to operate in the 403MHz-to-470MHz bands without degradation in specification. The mobile has an eight-character alphanumeric display and meets military specs 810C, D and E. It meets EIA and U.S. Forestry Service specs for vibration and shock.

### Battery-saving device switches equipment on, off

The ChargeGuard device automatically switches equipment such as two-way radios, mobile phones, PCs and mobile data terminals off and on at programmable intervals. The ChargeGuard unit is programmable from 15 minutes to 15 hours. The unit offers equipment protection, as well, with low-voltage disconnect, high-voltage disconnect and reverse polarity protection features. The device is available in 12V and 24V models.



Circle (301) on Fast Fact Card

### Leg ground strap features stainless steel clamps

Lightning Master's tower leg ground strap provides economical, low impedance grounding for virtually any tower. The straps are constructed of copper and are plated to assure minimum dissimilar metal corrosion problems.



Circle (302) on Fast Fact Card

### Software computes antenna characteristics

Software from Austin Antenna computes characteristics for short-loaded dipoles, dualband trap dipoles and calculates element frequency scaling. Sections include wire gauge tables; dielectric constants; drill sizes; taps, tap drills and thread clearance; metric and units conversion; windload calculations for vertical antennas; and an antenna gain calculator for any vertical antenna aperture. The software is IBM compatible and requires VGA graphics.

Circle (306) on Fast Fact Card

### Vari-Tilt antennas provide expanded coverage

The ASP-977 series of omnidirectional base station antennas offers Antenna Specialists' field-adjustable Variable Electrical Beamtilt (VEB). The ASPA977 (806MHz to 869MHz) and ASPJ977 (872MHz to 960MHz) provide coverage for TACS, ETACS, GSM, paging and 800MHz/900MHz trunking systems. The beamtilt tuning scheme permits accurate adjustments from  $-3^{\circ}$  to  $-8^{\circ}$  below the horizon before or after the antenna is installed.

Circle (312) on Fast Fact Card

### Software provides data management, real time reception

Version 1.3 from TSR Technologies provides real time traffic reception and data management on its Cellscope and Pagetracker system. The software operates on any AMPS or ETACS cellular system, or on any POCSAG, Golay or NEC paging system.

Circle (327) on Fast Fact Card



## Catalog lists RF power measuring equipment

The 50th anniversary catalog from **Bird Electronic** contains detailed descriptions and specifications with many photos of RF power measuring equipment and accessories. Along

Circle (403) on Fast Fact Card

## Catalog describes BETRS equipment

Telephone utilities can take advantage of the newly created wireless exchange system using the 454MHz to 460MHz band. A catalog from **Scala** exclusively for the Basic Exchange

with its line of wattmeters, the catalog includes selections of RF power calorimeters, plug-in elements, line sections, QC connectors, RF loads and attenuators.

Telephone Radio Service (BETRS) incorporates antennas for subscribers, central sites, mounting accessories and technical information.

Circle (404) on Fast Fact Card

## Catalog details test equipment

A catalog detailing portable and benchtop test and measurement instruments is available from **Bel Merit**. It is geared toward the engineer, student, technician or hobbyist who tests, repairs or assembles electronic or electrical equipment. Highlighted in the catalog are full multifunction digital multimeters with holster, digital clamp-on current meters, bench instruments, non-contact voltage detectors, electrical voltage testers, continuity checkers, ac circuit analyzers and oscilloscope probes.

Circle (402) on Fast Fact Card



## Brochure describes AVL products

A brochure from **Position Technology** features its line of AVL products. It includes outputs for different types of transmitters, optional receiver/transmitters and other optional equipment.

Circle (406) on Fast Fact Card

## Catalog lists signaling equipment

A color, user-friendly catalog shows **Selectone's** comprehensive product line of tone signaling and remote control accessories. Featured products include CTCSS, two-tone sequential, DTMF and burst tone signaling, remote controls, shared repeater panels, automatic number identification (ANI) and voice encryption. Included is a section describing products that will be introduced in the near future.

Circle (407) on Fast Fact Card

## Brochure describes circulators and isolators

A six-page brochure from **Tx Rx Systems** describes ferrite circulators and isolators for the 118MHz-to-960MHz range, as well as RF loads and harmonic filters.

All forward and reflected power ratings are based on continuous duty conditions to preclude uncertainties arising from unspecified duty cycles or design conditions. Explicit RF load specifications include resistor element power rating, heatsink surface area and power density.

Circle (401) on Fast Fact Card

# The ULTIMATE PROTECTION...

**NOBODY...but NOBODY** beats the quality and workmanship of **LEATHERSMITH's** cases for two-way radio equipment.

**LEATHERSMITH's** specially-developed, steer hide leather cases are expertly designed by Pennsylvania craftsmen.

**LEATHERSMITH's** cases feature durable, rust-proof nickel-plated snaps and fasteners. Quick disconnect swivels are optional on all models in polished steel and sturdy molded nylon.

Your choice of covers is included in our low, low prices.

"Delivered on time ALL the time!"

Call TODAY for your FREE information pack  
Toll-Free 1-800-233-0440 Fax 717-933-5653

The Right Choice

## LEATHERSMITH

**Rich, full-grained leather cases for the latest models In stock now!**



LOGO IMPRINTS IN CHOICE OF COLORS

417 Frystown Rd.  
Myerstown, PA 17067

Circle (66) on Fast Fact Card

# INTERFERENCE LOCATION



- ★ 50 to 1000 MHZ
- ★ Stuck Microphones
- ★ Cable TV Leaks
- ★ Jammed Repeaters & Cell Sites



New Technology (patented) converts any VHF or UHF FM receiver into a sensitive Doppler shift radio direction finder. Simply plug into receiver's antenna and external speaker jacks. Models available with computer interface, synthesized speech, fixed site or mobile - 50 MHz to 1 GHz. Call or write for details.

**DOPLER SYSTEMS, INC.**

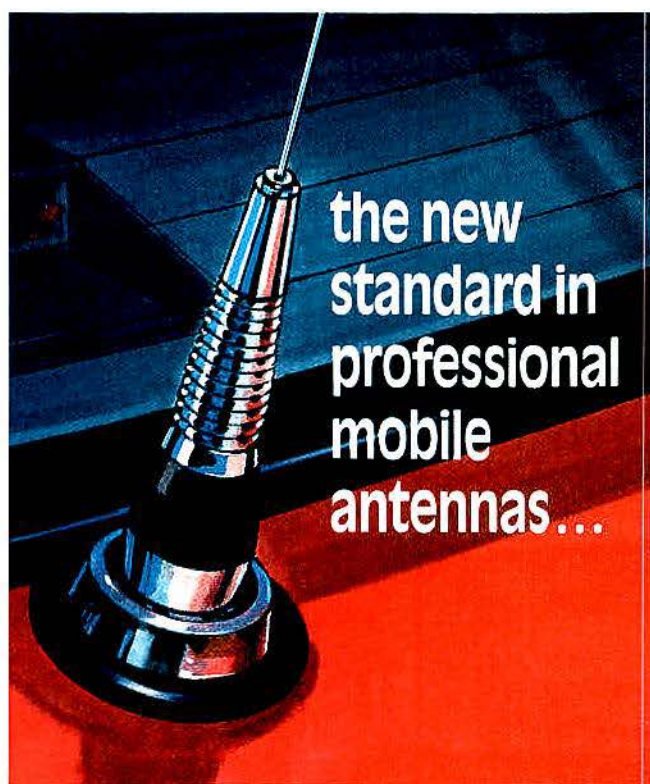
P.O. BOX 2780  
CAREFREE, AZ 85377

(602) 488-9755  
FAX (602) 488-1295

Circle (61) on Fast Fact Card



# as Only from antenna specialists...



## New! PRO-5000™ SERIES

No more compromises with quality, performance or value. You get it all with our PRO-5000™ VHF and UHF professional mobile antennas. All new A/S design from the ground-plane up for optimum reliability.

- Triple O-ring seals — runs rings around others for superior protection from water and other contaminants.
- 100% factory-tuned and locked coils for long-term frequency stability.
- All internal connections soldered or press-fit for electrical integrity.
- Clean, contemporary, functional design
- Stainless steel whips: VHF models DURA-CON® plated for highest conductivity.
- Power rated 150 Watts; VSWR less than 1.5:1; Gain 3 dB (VHF); 3 dB or 5 dB (UHF).



**the antenna specialists co.**

a Member of The Allen Group Inc.

30500 Bruce Industrial Parkway  
Cleveland, OH 44139-3996  
Tel. 216/349-8400 • Fax 216/349-8407



Circle (64) on Fast Fact Card

## F eedback

### 'Not enough frequencies available'

According to 85.7% of the respondents to the June 1992 "What Do You Think?" questionnaire, land mobile radio frequencies are too crowded. Readers' responses include:

- "Lack of spectrum and poor prior coordination."
- "Limited spectrum for number of users. It is not just distance apart, it's power!"
- "No room to expand."
- "Too many users on each channel."

Dealers contributed the majority of responses received in this survey, with 42.9%. Other participants include:

Public safety and government	17.1%
Business and industrial users	14.3%
Service providers	14.3%
Transportation	2.9%
Other/No response	8.6%

85.7% of the respondents operate on conventional mobile radio frequencies. The following statistics show other frequencies used by the readers (multiple responses add up to more than 100%):

Conventional mobile radio	85.7%
SMR	45.7%
PCP paging	37.1%
Mobile data	20.0%
Cellular	17.1%
RCC paging	14.3%
Automatic vehicle location	11.4%
Marine	2.9%
Other	20.0%

Opinions vary on how regulation can relieve congestion. Readers' responses include:

- "Better enforcement of existing rules."
- "Better frequency coordination."
- "Re-instate FCC power to regulate and disband the middlemen (i.e. NABER)."
- "Better monitoring."
- "Complete refarming."
- "Regulations that encourage new modulation technologies (i.e. spread spectrum; ACSB)."
- "Stiffer enforcement of basic rules of enforcement."

Digital and narrowband technologies are suggested by readers as technologies they believe can improve frequency use. Other responses include:

- "ACSB."
- "Convert many existing 150MHz, 450MHz and 460MHz repeaters to trunked mode."
- "Making radios more spectrum efficient. Pushing more 12.5kHz and 5kHz spectrum technology."
- "Time domain multiplexing. The telecommunications industry has been using this technology for 20+ years (T1). It's time radio adopted this technology."
- "Open up more spectrum to conventional mobile radio users."





**Ron Nessen** departs Westwood One, Washington, DC, the parent company of the Mutual Broadcasting System and the NBC Radio Network, as vice president of news to become first vice president of public affairs and communications at Cellular Telecommunications Industry Association, Washington, DC.

**Ron Cooper** exits General Electric, Lynchburg, VA, as president of Consulting Services, a GE subsidiary, to join PRC, McLean, VA, as president of PRC's Commercial & International group.

Changes at Unipage, DeSoto, TX, stemming from the sale of the company to Motorola, Schaumburg, IL:

**Patrick R. Koons** exits Teknekron Infoswitch, Dallas, to become president of Unipage, replacing company co-founder **Tim Minter**, who continues as a Unipage consultant.

Company co-founder **R. Gene "Bud" Forester** steps down as vice president and continues as a Unipage consultant.

**Joe Krystofik** exits SGS Thomson, Dallas, as business unit manager and joins Unipage as vice president of marketing.

**Chuck Rauch**, a resource manager for transmitter design at Motorola in Schaumburg, moves to Unipage as vice president of operations.

**Jeff Starling**, manager of manufacturing and hardware development engineering for paging terminals at Motorola's Boynton Beach, FL, facility, moves to Unipage to become manufacturing operations manager.

**Bob Treasure** exits Beep California, Scottsdale, AZ, as president and becomes area manager for western states at Unipage.

**Mark Middlekamp** departs Cincinnati Bell Telephone, Cincinnati, as product manager of paging services to join Unipage as systems marketing representative.

**Susan Lee Austin**, a co-founder of SBT, Allentown, PA, joins Unipage as marketing assistant.

Changes at The Antenna Company, Broadview, IL:

**Steven Maher**, director of training, moves up to midwest regional sales manager.

**Christina Seiler**, western regional manager, becomes north central regional manager.

**Betsy Popp**, midwest regional manager, moves to western regional manager.

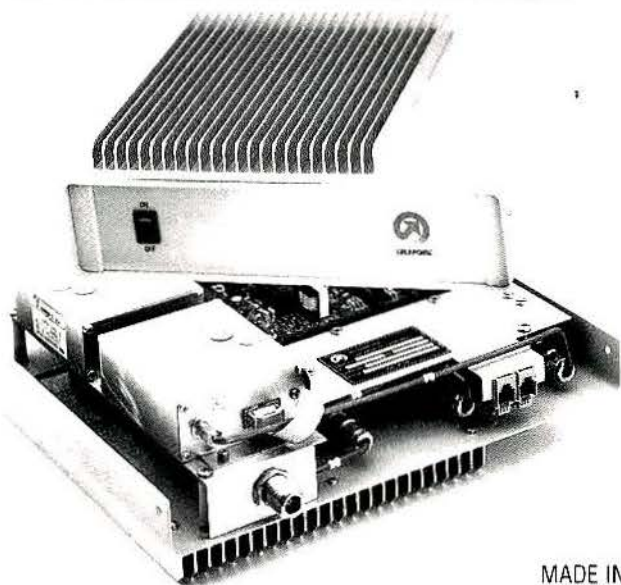
Changes at Multiplier, Mt. Kisco, NY:

**Rich Simels** leaves V Band, Elmsford, NY, as director of sales to become national sales manager for Multiplier.

**Craig Hindley** leaves Antenna Products, Aylesbury, Buckinghamshire, England, as northern sales manager to head sales and marketing efforts in behalf of Multiplier Ltd., Hursted, England, the company's U.K. sales and distribution facility.

# AT LAST... DIGITALLY-CONTROLLED RADIO TELEPHONE SYSTEMS

**TRANSMIT VOICE, FAX AND DATA FOR AN  
INCREDIBLY LOW COST WITH TELEPOINT'S FULL  
DUPLEX PRIVATE RADIO TELEPHONE LINKS.**

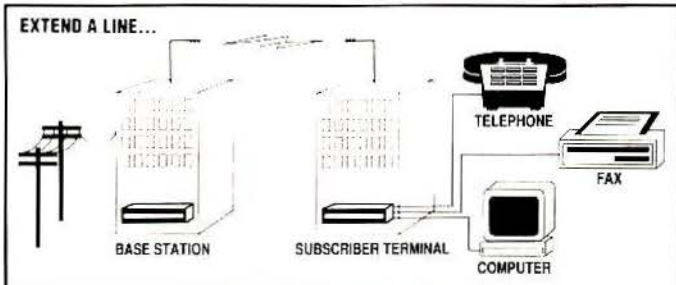


MADE IN  
U.S.A.

**The Unitel RTL-1000 is the most advanced radio telephone link ever developed...giving you all these benefits, and more:**

- Digital control for absolute reliability
- Exceptional audio quality-produced by a compander
- Full duplex selective intercom
- 900/800 Mhz/UHF & VHF bands
- 2 to 100 watts RF output
- Currently in operation worldwide

**At Telepoint, we deliver quality, performance and reliability...with the radio telephone systems of the future!**



**CALL NOW**

**FOR MORE INFORMATION ON TELEPOINT'S ENTIRE LINE OF TELEPHONE LINE  
EXTENDERS...AND YOUR FREE SYSTEMS PLANNING GUIDE.**

**TELEPOINT INC.**

1022 South La Cienega Blvd., Los Angeles, CA 90035

Toll Free: **(800) 333-6444**

Phone: **(310) 652-3666** Fax: **(310) 652-0777**

Circle (65) on Fast Fact Card



**Combining antennas:**

The July article "Combining and Phasing Land Mobile Base Antennas" by Brian Henderson, P.Eng., was quite informative, although several important bits of information were left out.

First, when phasing antennas together, it is important to keep their polarities the same.

For example, when using two yagi antennas, make sure both antenna impedance matching sections (the grounded side of the driven element or gamma match) are aligned in the same direction. It does not matter in which direction they are aligned as long as the direction is the same.

When phasing larger antennas, such as four-bay arrays, and one antenna is turned upside down so the feedpoint is in the center between the two antennas, exactly 0.5-wavelength of feedline must be added to one side of the matching harness. This keeps the antennas in phase. Without the extra feedline, the signals are 180° out of phase, and the signals they broadcast cancel one another at the fringe of the coverage area.

Second, antennas must be placed in the same vertical or horizontal plane to achieve a 3dB gain over the original antenna pattern.

Failure to keep the antennas in the same plane alters the antennas' radiation pattern by signal phase cancellation.

For example, adding a second antenna on the opposite side of a tower from a previously side-mounted antenna to reduce the null caused by the tower may create another null in a different direction. Computer design programs can help to design a system carefully to avoid costly pitfalls. In addition, many antenna manufacturers offer free advice.

Mr. Henderson describes how to use two quarter-wavelength sections of 75Ω coax to phase two 50Ω antennas to one 50Ω feedline. A variation of this phasing harness uses a quarterwave stub of 62.5Ω coax on each end of a 75Ω feedline to make the feedline and antenna look like 50Ω to the transmitter.

I have used these stubs with a 0.75-inch 75Ω CATV hardline with good results. One sometimes can obtain con-

tinuous lengths of coax as long as several hundred feet as remnants from spools just for the asking.

There are many good books on antennas and feedline theory. One I recommend is *The ARRL Antenna Handbook*. It often is for sale at hamfests and is available from the American Radio Relay League, Newington, CT.

The book has more information than anyone would want to know. It is written in a manner that most technical people understand.

John D. Smith

Shop Manager

Gunby Communications

Leesville, SC

*Brian Henderson's response to John Smith's letter is too long to include in this month's letters column. It will appear next month.*

—DB

The toughest problem facing me on the job is:

- to have communication from work site to workshop and from work site to my residence.

Cris Raguro

Technician

Sharikat Fanniya Omanniya

Muscat, Oman

The two toughest problems facing me on the job are:

- keeping up with rapidly changing technology.
- finding parts for older equipment at a reasonable cost.

T.R. Swisher Jr.

Owner

Image Concepts

Columbus, OH

The two toughest problems facing me on the job are:

- adapting 800MHz trunking radios to underground mines.
- trying to find trunking mobiles and portables that have a decent size and volume.

Jean-Paul Saindon

Program Director

Noranda Technology Centre

Point-Claire, Quebec



# Mobile Radio Technology

The journal of mobile communications technology

## BUSINESS

Cameron Bishop, *Group Vice President*  
 Mercy Contreras, *Publisher*  
 Darren Sextro, *Marketing Director*  
 Evelyn Hornaday, *Promotions Manager*  
 Sally Nickoley, *Promotions Coordinator*  
 Dee Unger, *Advertising Business Manager*  
 Mary Birnbaum, *Advertising Production Supervisor*  
 Liz Turner, *Advertising Coordinator*  
 Tammy Kalebaugh, *Classified Advertising Coordinator*  
 Tom Cook, *Group Senior Managing Editor*  
 Doug Coonrod, *Corporate Art Director*  
 Czatdana Inan, *Group Director of Special Projects*

## ADMINISTRATION

R.J. Hancock, *President*  
 Sandra Milan, *Corporate Circulation Director*  
 Michele Bartlett, *Circulation Director*  
 Meg Fisher, *Circulation Coordinator*  
 Customer Service, 913-967-1711

## ADVERTISING SALES OFFICES:

ENGLEWOOD, COLORADO  
 Ruth Breashears, *Northeast region (Eastern Canada, CT, MA, MD, NJ, NY, OH, PA, NH)*  
 Carla M. Gamino, *Southeast region (VA, FL, GA, NC, SC, TN, AL, AR, MS, MO, OK)*  
 Diane Hite, *Midwest/Southwest region (AZ, CO, LA, NM, TX, WY, UT, NV, MT, NE, KS)*  
 Mercy Contreras, *Publisher*  
 333 W. Hampden Ave., Suite 806  
 Englewood, CO 80110  
 Phone: 303-762-1249  
 Fax: 303-762-0069

SAN RAFAEL, CALIFORNIA  
 Dennis Hegg, *West region (Western Canada, CA, OR, WA, AK)*  
 950 N. Gate Drive, Suite 207  
 San Rafael, CA 94903  
 Phone: 415-491-1442  
 Fax: 415-491-1842

CHICAGO  
 Janet Blaney, *East Central region (IL, IN, MI, IA, MN, WI)*  
 55 E. Jackson, Suite 1100  
 Chicago, IL 60604  
 Phone: 312-435-2340  
 Fax: 312-922-1408

OXFORD, ENGLAND  
 Richard Woolley  
 Unit 3, Castle Farm Business Centre, Clifton Road  
 Deddington, Oxford, OX15 4TP, United Kingdom  
 Phone: +44 (0)869 38794  
 Fax: +44 (0)869 38040

## CLASSIFIEDS

Jennifer Hinkle  
 9800 Metcalf Ave.  
 Overland Park, KS 66212-2215  
 Phone: 913-967-1927  
 Fax: 913-967-1901

## LIST RENTAL SERVICES REPRESENTATIVE

Greg Hembree  
 9800 Metcalf Ave.  
 Overland Park, KS 66212-2215  
 Phone: 913-967-1872  
 Fax: 913-967-1897



**The Warner Group**  
Management Consultants

- Police/Fire Systems Planning
- Radio/CAD/E9-1-1/Dispatch
- Technology Project Management
- Telephone Systems Analysis
- Data Network Design
- GeoBased Systems

5950 CANOGA AVENUE, SUITE 600  
WOODLAND HILLS, CALIF. 91367  
(818) 710-8855 • FAX (818) 710-1467

**SFA INC.**  
Telecommunication & Information Science Division

Public Safety, Transit, Government & Industry

CORPORATE OFFICE  
Donald P. Nowak 1401 McCormick Drive  
Manager Landover, Maryland 20785

(301) 925-9400  
(800) 787-2732  
Fax (301) 925-8612

**COMMUNICATIONS CONSULTING SERVICES**

**RAM**

10 Woodbridge Center Drive Woodbridge, NJ 07095  
(908) 636-6970  
Toll-Free: (800) 247-4796 • FAX: (908) 636-7260

**COMMUNICATIONS CONSULTANTS, INC.**

Offices Nationwide and International.

**Communications Engineering Services, P.C.**

Coverage Predictions • Terrain Analysis  
Propagation Studies  
Computerization of Manual Engineering Systems  
Site Selection • Frequency Allocations  
FM, TV, Land Mobile, Cellular, Paging Services

Richard L. Biby, P.E.  
6105-G Arlington Blvd. Falls Church, VA 22044 USA  
(703) 534-7880  
Fax: (703) 534-7884 root@comm-data.com

**Classified**

Advertising rates in **Mobile Radio Technology's** Classified Section are \$69.00 per column inch, per insertion, with frequency discounts available. There is a one inch minimum.

Ads larger than one inch are sized in 1/4-inch increments and billed accordingly, as determined by total size of the ad, including ruled borders and rounded up to the nearest 1/4 inch.

Blind box ads (replies sent to **MRT** for forwarding) are \$30.00 and Fast Fact reader service numbers are available for \$25.00 per service, per insertion, to cover processing and handling costs.

Optional color, determined by **MRT** on an issue-by-issue basis, is available at \$150 per insertion.

A prepayment discount of 5% is available for all 6x or larger frequency classified advertisers who prepay their full 12 month schedule.

No agency discounts are allowed for classified advertising.

Contact Jennifer Hinkle at (913) 967-1927 or fax (913) 967-1901 to place your classified ad. Or send your advertising materials and order to Tammy Kalebough, **Mobile Radio Technology, Classified Advertising Department**, 9800 Metcalf, Overland Park, KS 66212

**RADIO PAGER CRYSTALS**  
Specializing in MOTOROLA NEC UNIDEN

Precision crystals at affordable prices.  
Common frequencies for popular pagers in stock.  
Custom order and specialty crystals welcome.

★★ SAME OR NEXT DAY SHIPPING ★★

**CRYSTRONICS, INC.**  
We've got the crystals

Phone 305-566-6949 Fax 305-566-5971

**GE PORTABLE SERVICE**

- FAST TURN
- WARRANTY
- \$37.00 hr./2 hr. MAX
- PARTS GE LIST
- RETURN UPS PAID

**Smith Communications Service**  
2121 Parrish Ave., Owensboro, KY 42301  
502-683-0936

**SHAFFER & ASSOCIATES, INC.**  
CONSULTING ENGINEERS

- FCC Applications • Propagation Analysis
- AM, FM, TV, LPTV, MMDS
- Radiation Field Measurements
- Bid Specification Development

3050 Post Oak Blvd., Suite 1700  
Houston, Texas 77056  
Tel. (713) 621-4499 Fax. (713) 621-5751

**Communications Technology Associates**  
A Division of Hayes, Sears, Mattern & Mattern, Inc.

PLANNING AND DESIGN:

- 2-Way Radio
- MV & F/D
- CAD/MDT/AVL/Paging

PLUS:

- Complete A&E Services
- Bldgs, Towers, Pwr Sys
- Structural Engineering

CTA Box (804) 239-9235 P.O. Box 4879  
FAX (804) 239-9221 Lynchburg, Virginia 24502

**RCT**

RAYMOND C. TROTT  
CONSULTING ENGINEERS, INC.  
1425 GREENWAY DRIVE, SUITE 350  
IRVING, TEXAS 75038  
214-560-1811

RAYMOND C. TROTT, P.E.  
PRESIDENT

LAND MOBILE • MICROWAVE COMMUNICATIONS SYSTEMS

**TCS**

**Jerry L. Simmons**  
Communications Systems Consulting  
Land Mobile & Microwave Systems

P.O. Box 884 Ph (409) 588-3200  
Montgomery, TX 77356 Fax (409) 588-4434

**THE PORTABLE DEPOT, INC.**  
SPECIALIZING IN GENERAL ELECTRIC PORTABLE SERVICE

- FACTORY TRAINED TECHNICIANS
- SURFACE MOUNT TECHNOLOGY
- FACTORY APPROVED NATIONWIDE
- PUBLIC SERVICE TRUNKING
- VOICE GUARD CERTIFIED

• MPD, MPA, TPX, PCS AND ALL CURRENT PRODUCTS •  
Route 2, Box 338C • Lynchburg VA 24501  
804-237-3427

**PORTA-TECH** PORTABLE TECHNICAL SERVICE, INC.

1106 Laxton Road • Lynchburg, VA 24502

GE Portable Radio Service Depot  
Factory Approved Nationwide

- Current Product Lines
- Voice Guard Certified
- Public Service Trunking
- Surface Mount Technology

FACTORY TRAINED TECHNICIANS FOR QUALITY SERVICE  
(804) 239-3049

Phone  
**Jennifer Hinkle**  
for Classified  
Advertising Information  
(913) 967-1927

**Equipment for sale**

**CHICAGO TOWER**  
41° 33' 10.0"N 87° 47' 09.0"W  
EXCELLENT LOCATION  
Below Market Rates  
WJYS-TV  
(708) 633-0001

**USED Radios WANTED!**  
California Radio → 800-231-0103

**MECHEM ELECTRONICS**

P. O. Box 7846 Fredericksburg, VA 22404 (703) 373-3888

Programming for MCX100, Syntor, Syntor X, and MX's Available

H43SXU1140 & 3140 5w VHF MX's DES  
H44SSU3140 4W UHF MX's PL  
H35AAU5150AN 800 MC MX  
DES Key Loaders  
Mitrek 29.7-39 & 39-50MC  
Mitrek Accessories, SYS 90, Sel Call; ACM; Scan & Siren Available  
MCX100 DES Scan 10W 148-174  
C71RCB3146 100W C.D. 36-42 PL Dual RX  
C42RCB3105DA 25W C.D. 72MC PL Rptr  
Q1002 Micor Suitcase VHF Base

C53RTB3125 60W PL 150-162 DC Control  
C73RTB1106 100W CS or PL 142-150 & 150-162 MC  
MBX Brief Case Base 30W 12F DES VHF  
C73RXB1106 100W C.D. DES Rptr w/duplexer  
L44JJB3100AM Mitrek Console/ette  
Martis EMS Base & ER Console  
Q2208 DES Comparators w/5 SQM's; 5 Aux. SQM's  
Command; Tone key; Logic Modules  
Spectra Tac RX's CS LB & VHF  
RCA Votec Comparator & Receivers  
RTX4007; TEK5 & MORE

Visit our shop at 1003A  
Tyler Street in Fredericksburg.  
Direct all correspondence to our  
P.O. Box.



"Find Out What Everyone Is Talking About!"

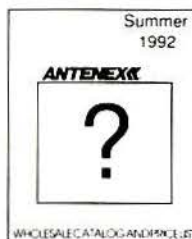
**ANTENEX**

2000-200 Bloomingdale Road, Glendale, IL U.S.A.

Call or write for complete catalog on  
**ANTENEX** mobile, portable, and  
base antennas, mounts, cable,  
connectors, and accessories!

Order: 800-323-3757

Fax: 800-851-9009



Circle (76) on Fast Fact Card



**BUY-COMM-CO. INC**  
NEW & USED

**MOTOROLA**

800 Mhz Trunked Radios

1-800-347-4121

(602) 585-3900

FAX (602) 585-6900

29669 North 45th Street  
Cave Creek, Arizona 85331

**MITREKS!**

110 Watt, PL or DPL. 4 channel  
29-39 or 39-50 Mhz. MINT!

**\$495. 800-231-0103**



**GENERAL COMMUNICATIONS**

**MIDLAND LMR**  
LAND MOBILE RADIO

**WHOLESALE PRICES ON ALL  
MIDLAND RADIOS!**

**CALL TODAY!**



1-800-356-3200

5157 Anton Dr.  
Madison, WI  
53719

**RADIUS**

★ low-low-low ★

MOSS COMMUNICATIONS INC.  
1-800-767-1963

**ROHN TOWERS — 34% Discount**

Also discounts on Antenna Specialists,  
Maxon, Midland, Kenwood, Ritron,  
Uniden Radios.

**HILL RADIO**

P.O. Box 1405, Bloomington, IL 61702  
309-663-2141

**Rocks**

**Crystals For Pagers & Radios**

• Lifetime Guarantee on Bomar Crystals • Competitive Pricing  
• 48 Hour, 1 Week and 2-3 Week Service

**Call 800-526-3935 • Fax 800-777-2197**

201 Blackford Ave.

**BOMAR**

Middlesex, NJ 08846

Circle (78) on Fast Fact Card

SAVE THIS AD • WHY PAY MORE? • SAVE THIS AD

**AIR COMM**

**MOTOROLA Radius**

P100 synthesized portable radio

P100 VHF 5 Watt  
2 Chan. ~~\$323~~ **\$270**

P100 UHF 4 Watt  
2 Chan. ~~\$323~~ **\$300**

**Buy Now  
— Any Quantity —**

**In Stock For Immediate  
Shipment**



SAVE THIS AD

Radio includes high power nickel  
cadmium battery, standard rate,  
desktop charger, flexible antenna,  
audio jack, radio holder with belt  
clip and a three year warranty,  
parts and labor



**Rapid-Rate Desktop Charger**

Delete Standard Charger: \$27 (New)  
Delete Standard Charger: \$22 (Recond.)

Without Radio Purchase: \$37 (New)  
Without Radio Purchase: \$30 (Recond.)



**Remote Speaker/Microphone**

With Radio Purchase: \$45 (New)  
With Radio Purchase: \$25 (Recond.)

Without Radio Purchase: \$55 (New)  
Without Radio Purchase: \$35 (Recond.)



**Carry Cases (Used)**

With Radio  
Purchase: \$5

Without Radio  
Purchase: \$12



**Six-Unit Rapid-Rate Charger**  
(Used)—A wall or desk-  
mounted charger that can  
accommodate up to 6 radios  
with battery or batteries alone.  
Provides a one hour charge  
rate for each battery.

With Radio Purchase: \$150  
Without Radio Purchase: \$175

**AIR COMM CORPORATION**

4614 E. McDowell Road, Phoenix, AZ 85008 • Sales (602) 275-4505 • Fax (602) 275-4555

SAVE THIS AD • SAVE THIS AD • SAVE THIS AD • SAVE THIS AD

Circle (77) on Fast Fact Card

**COOK'S COMMUNICATIONS**

**GE**

**LTR**

160 N. Broadway  
Fresno, CA 93701



**VISA  
MASTERCARD**

**MOBILE AND PORTABLE RADIOS AT  
WHOLESALE PRICES**

**1-800-233-8818**

**TOUCH-TONE DECODER/DISPLAY  
& ASCII CONVERTER BOARD**



Model TDD-8 decodes and displays all 16 DTMF digits.  
Digits are displayed on eight LED's. 32 character  
memory can be scrolled. It will accept almost any audio  
source. Ideal for remote DTMF control or data entry  
using a telephone keypad. ASCII serial output can be  
connected to your computer. IBM compatible software  
included for displaying, storing and/or printing time,  
date and number for automatic logging.

**TDD-8 DTMF DECODER/DISPLAY/ASCII \$99**

**CAB-1 AUDIO & SERIAL CABLES \$20**

**PS-12 110VAC TO 12VDC POWER PACK \$10**

add \$5 S/H - VISA/MC ACCEPTED

MoTron Electronics TEL: 1-800-338-9058

310 Garfield St.#4 (503)-687-2118

Eugene, OR 97402 FAX: (503)-687-2492

Touch Tone is a trademark of AT&T



Now, here's a switch!

## CHARGE GUARD

automatic **ON/OFF** timer switch  
for two-way radios, cellular phones.

**EASY TO INSTALL.**

NO IGNITION SWITCH CONNECTION!

**PROGRAMMABLE.**

15 MINUTES TO 15 HOURS!!

**Prevents Dead Batteries.**

MADE IN U.S.A.

PROTECTS YOUR RADIO.

SUGGESTED LIST ONLY \$74.95 MODEL CG18-12N

12 AND 24 VOLT MODELS AVAILABLE

CALL NOW FOR MORE INFORMATION!

ASK ABOUT  
OUR NEW  
DEALER KIT!!



**CHARGE GUARD**

400 Highland Avenue  
Altoona, PA 16602

**800-458-3410**

©1991 ChargeGuard

Circle (79) on Fast Fact Card

## Channel Elements

100,000 Freqs in Stock!  
MASTR II, MVP, EXEC II  
MICOR, MOCOM & MOTRAC

\$20 w/trade or \$25 w/o trade  
Lifetime Warranty

3-Day Standard Delivery

1-800-237-9654

FAX: 513-542-8870

**CHANNEL ELEMENT HQ.**

4120 Kirby Road

Cincinnati, OH 45223

We Buy Channel Elements.

## UNtenna

Low Profile • Low Band  
Antenna for Radio  
Communication



### FEATURES:

- Up to 95% Height reduction
- Easy Installation
- High Performance • Low Cost

Model CR109A  
**THE ULTIMATE  
LOW BAND**

COM-RAD INDUSTRIES

PO Box 554, Grand Island, NY 14072

For Immediate Fax Info & Technical Assistance,  
Telephone: 716/773-1445

## ACTIVE FILTERS

AND

## REEDS

FOR MOTOROLA PAGERS  
FAST DELIVERY

**Branco.**

PH (513) 773-6255

P.O. BOX 1482, PIQUA, OHIO 45356

LOW \$555
→

# Radius

**CALIFORNIA RADIO®**  
16943 - 6200 Road Montrose, COLORADO 81401

We Want  
*YOUR business!*

ORDERS: 800-231-0103

QUESTIONS: 303-249-1414

FAX: 303-249-4334

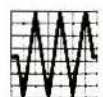
CALL NOW

## The New Way To Re-Crystal!

Top Quality Ultra-High Shock Crystals For Pagers & Radios  
Motorola, GE, NEC, and all others!

Your old friends at Standard Communications' Crystal Division are now your old friends at Frequency Management. We've formed an independent company to serve you better. Greater Capacity, New Larger Facility, Same Experienced Pros.

Priority Delivery Available:  
24 hr./72 hr./5 day/10 day  
Standard: 15 days



**Frequency  
Management**

A Division of The D.W. Thomas Companies, Inc.

15302 Bolsa Chica St., Huntington Beach, CA 90649 800/800-9825 (FAX 714/890-1832)

Circle (80) on Fast Fact Card

## RAMSEY COM-3

The communications service monitor that's missing one feature . . . HIGH PRICE!

- Frequency coverage 100 KHz to 999.999 MHz
- Signal Generator 0.1 uV to 10,000 uV with reverse power protection . . . no more front-end blowouts!
- Built-in 1 GHz and audio frequency counter
- Modulation includes 1 KHz, CTCSS or external
- The most popular low cost high performance monitor . . . thousands sold worldwide
- Extremely portable, only 13 pounds includes rechargeable battery at no extra cost
- Call for free 10 day trial in your shop



Ramsey Electronics Inc.

793 Canning Pkwy  
Victor, NY 14564

716-924-4560

716-924-4555 (FAX)



**\$2995.00**

Circle (81) on Fast Fact Card

## MOTOROLA CENTRACOM I & II

Console components

BOUGHT & SOLD

Telecommunications  
Engineering Associates  
409 Wildwood Dr.  
So. San Fran., CA 94080  
Ph: (415) 871-4200

Circle (82) on Fast Fact Card

## STICKERS, LABELS, NAMEPLATES

### ADVANCE LABEL & TAG

1725 N. McDONALD ST.  
McKINNEY, TEXAS 75069  
1-800-466-5345 214-542-5345

We design and manufacture LABELS that STICK and guarantee the QUALITY.

CALL FOR FREE SAMPLES

Outstanding quality at competitive prices.  
Se Habla Español



# NEW IDEAS FROM



Automation &  
Electronics  
Engineering, Inc.

13667 Floyd Circle  
Dallas, TX 75243  
800-527-4596  
800-383-9180 FAX

## SOLID STATE DC TERMINATION PANEL

### DP7SS SINGLE FUNCTION DC TERMINATION PANEL

- Includes solid state relays
- Includes lightning/surge protection
- Easy installation
- Easy to configure to almost any radio
- Built in amplifier at no additional cost

### DP-8SS DUAL FUNCTION DC TERMINATION PANEL

- Includes solid state relays
- Includes lightning/surge protection
- Easy installation
- Easy to configure to almost any radio
- Built in amplifier at no additional cost
- Adjustable from -24ma to +24ma
- LED indication of ma adjustment
- LED indication of 600 ohm phone line
- Can be configured for any combination of milliamps, including REVERSE POLARITY or LOW CURRENT MONITOR

BOTH PANELS ARE IN STOCK AT THE FACTORY OR AVAILABLE FROM ANY OF OUR DISTRIBUTORS.

★ THE PANELS HAVE A NEW LOWER PRICE!!!!!! ★

Circle (83) on Fast Fact Card



## GENERAL COMMUNICATIONS, INC.

MOBILE COMMUNICATIONS AUTHORIZED DEALER

## #1 GE DEALER IN THE USA!

Largest Inventory ▲ Quality Service  
Fastest Delivery and Best Prices



**1-800-356-3200**



Mobile  
Communications

5157 Anton Dr. ▲ Madison, WI 53719

Circle (84) on Fast Fact Card

**STOP  
AND  
SAVE!**

## MOTOROLA RADIUS

End users shop first then call for the best price

**PROCOMM**  
**805-497-2397**

Holiday Wishes To All, Especially To Our Valued Customers!  
Christmas Special: GP300 UHF 8 Ch., 4W With All Accessories:

**\$490.00 ea.**

Circle (93) on Fast Fact Card

Use

Mobile

Radio

Technology

Classified

Ads

## COMPLETE CHANNEL ELEMENTS ON YOUR FREQUENCY FOR

**\$25 - \$35!!!**

**ORDERS ONLY:**

**1-800-237-6519**

**INQUIRIES AND IN LA:**

**504-361-5525**

- ☐ Motrac; Micor, Mocom; Mitrek; Etc.
  - ☐ MT's, and GE Elements. Call for prices.
  - ☐ Any desired Frequency available for fast delivery.
  - ☐ Lifetime Warranty on Crystals
  - ☐ Trade-in credit on your Old Channel Elements
  - ☐ We Buy Used Elements
- Try us first. We always have your frequency available.

**NKX**

**1814 Hancock St.  
Gretna, LA 70053**

## USED 2-WAY RADIOS

Call Sid Cohen

at **AIR COMM—Phoenix, AZ**

**(602) 275-4505 • Fax (602) 275-4555**

30%-70% savings on Motorola, GE, EFM mobiles, base stations, portables, pagers, repeaters—primarily solid state—all frequency bands. Also, accessory items: Motorola "System 90" control heads. PL and paging reeds, channel elements. Cash quotations made for purchase of above equipment.



**4614 E. McDowell Rd.  
Phoenix, AZ 85008**

## CLEAN MOTOROLA RADIOS

<b>MOBILES &amp; PORTABLES 800 MHZ TRUNKED</b>	
15W MOSTAR W/MIC BRACKET & POWER CABLE	\$ 395
15W MAXTRAC B1 & B5 W/ACCESSORIES	\$ 495
15W MAXTRAC B7 10 SYS. SCAN	\$ 595
35W MAXTRAC B7 10 SYS. SCAN	\$ 695
35W SYNTOR X2 OR X3	\$ 250
35W SYNTOR X15 SYS/15 SUB/TALKAROUND	
<b>NEW</b>	
35W SPECTRA B5 10 SYS/SCAN/TALKAROUND	\$ 995
25W PP1000X	\$ 695
2W MTX800	\$ 595
3W STX SMARTNET 1 & 11 GE/MNI	\$1,895
BASE STATION PACKAGE PIS, DESK MIC	\$ 200
<b>MOBILES &amp; PORTABLES 900 MHZ TRUNKED</b>	
12W B6 7 B7 MAXTRAC S	\$ 595
12W B5 SPECTRA 10 SYS/10 SUB/SCAN/CONV	\$ 695
30W B5/B7/B9 SPECTRA 10 SYS/SCAN/TEL	\$ 995
30W L37VLB BASE W/3 REMOTES	\$1,495
2W MTX900 B3 & B4 6 SYS/3 SUB/CONV	\$ 995
<b>CONVENTIONAL RADIOS</b>	
110W VHF MITREK 4F PL/DPL ALL ACC'S	\$ 395
100W UHF MITREK 4F PL/DPL ALL ACC'S	\$ 495
100W UHF SYNTOR X 8F W/DIR MNT PRGM D	\$ 795
100W UHF MICOR 12F PL RECOND'D	\$ 150
60W VHF MITREK 4F PL/DPL	\$ 250
40W UHF SPECTRA 450-482 MHZ A3 TRNK MNT	\$ 995
45W VHF SPECTRA A3 99 MODES	\$ 995
30W 900 MHZ SPECTRA "AS" SCAN	\$ 595
60W LB MAXTRAC 2F 30-36 MHZ	\$ 350
45W 16F MAXTRAC SCAN PRGM'D	\$ 450
N1244 CONVERTA.COM W/12W SPKR & MIC	\$ 125
2W EXPO	\$ 295
4W UHF OR 5W VHF HT800/P200 6F	\$ 445
4W UHF OR 5W VHF HT50 2F	\$ 325
6W VHF SABER 11 DVP CAP NEW IN BOX	\$1,095
6W VHF SABER 1	\$ 695
4W UHF 99F MT1000	\$ 895
5W 16F VHF	\$ 695
23 GHz STARPOINT TELEMETRY 23 AT	\$1,500
<b>WE BUY STX - MTX - MAXTRAC - MT1000 - SABER</b>	
<b>MOSTAR - SYNTOR 9000 - SPECTRA - HT500 - M400</b>	
<b>AND ALL RADIUS UNITS</b>	

**LOWEST NEW RADIUS RADIO PRICES IN USA - GUARANTEED**

GP300 8F W/CHRG \$499 P110 \$352 M100 \$314

**RADIO EXPRESS INC.**

703-266-1928 FAX 703-930-8710

Circle (85) on Fast Fact Card







## Classified

### For Sale Centra Com I Centra Com II -Whole or in Parts-



Centra Comm II  
Engraved Buttons.  
\$6.50 per button.  
All orders shipped  
within 48 hours.

### Centra Com II Reprogramming and Custom Changes

Northeastern Communications Inc.  
Waterbury, CT 06708  
(203) 575-9008

### USED PAGERS

Motorola and NEC. Reconditioned on  
your channel w/warranty, or "as is".

**ACS** (303) 337-4811  
FAX (303) 337-3084

### BUYING ERICSSON - GE EQUIPMENT CALL OR FAX FOR QUOTE

Rangr VHF 110W w/S550 scan ..... \$650  
Midland 70-050C 42-50 w/acc ..... 150  
MLSL260 42-50 w/acc ..... 325  
AEROTRON 460MHz syn. mobile ..... 95  
CUSTOM MVP 42-50 w/acc ..... 150  
CUSTOM MVP, VHF w/acc ..... 125  
MVP HOUSING PANELS PARTS KITS ..... call  
Delta-S 150-174 no. acc. 110W ..... 275  
Delta-S 450-470 40W S-990 acc. .... 350  
Delta-S Low band and "T" band ..... Call  
VHF PLS Port. 16 ch w/GESTAR ..... 225  
PLS/MPD/MPA Multi-chgr, new ..... 125  
Phoenix-SX 406-430 16 ch. new ..... 225  
MASTR II 150-174 110W ..... from 115  
MASTR II mobile cables ..... 20  
MASTR II VHF "E" package, 110W  
DFE W/C-500 scan accessories ..... 150  
S-990 128 ch. head w/warranty ..... 125  
NEW CELLULAR HANDSETS & Options ..... call  
MPS/MPR/MPX/MPI/MPD Chargers ..... call

**NEW LONDON TECHNOLOGY**  
231 Old Timberlake Road  
Forest, Virginia 24551

TEL 804-525-0068 FAX 804-525-0078

## Equipment for sale

**ICOM**  
**Sales and Service**  
**800-SPOT-CRIME**  
SWS Security

**MICORS! 110 Watt**  
Any band split. With P.L.  
With all accessories & tested  
**\$269.** 800-231-0103  
CALIFORNIA RADIO

### READ MY LINES "NO HIGH PRICES"

BUY — SELL — TRADE  
Call or write for flyer

**WOLFE COMMUNICATIONS**  
1113 Central Ave. • Billings, MT 59102  
406-252-9220

### Towers and Land For Sale

Former Western Union Sites in 20 States.  
Land, buildings and towers plus some  
microwave equipment for sale. Prices vary  
by location. For details call Agents Joyce  
Castille or Jim DeCicco.

800-852-8166 or 619-497-3458

### USED RADIOS at Low Prices!

• MICOR • GE  
• MITREK • RCA  
• PORTABLES • ACCESSORIES  
• MOCOM 70 • TONE ELEMENTS  
• MAXAR • CHRYSTAL ELEM.  
• RPTTS • BASE STATIONS

Large Quantities • (817) 433-5452

Collins MDR6, DMX2003, LMX1100, DMX13A;  
Wescor 363 channel banks; Ericsson Minilink  
18GHZ; 24 volt 100 A chargers; Andrew dish-  
es; TTI DACS; Harris 1201 switch; Ericsson  
AXB30 data switch; HP test equipment; Motor-  
ola & GE two-way radios; some fiber test  
equipment;

**805-945-5448 x200**

G.E. Century II VHF, 4 ch., 25w ..... \$95 ea.  
G.E. Master II VHF, "E" package, 110w DFE  
w/C-500 scan accessories ..... \$125 ea.  
Motorola Mitrek TB1JA3900BK 42-50 Mhz 110w  
PL w/acc. .... \$350 ea.  
Aerocom Six VHF, 4 ch., 25w ..... \$45 ea.  
Com-Spec TE-12P programmable 12 ch. PL  
deck ..... \$35 ea.  
Data-coder 5 DTMF Microphones ..... \$25 ea.  
**RAY SCHALL SALES & SERVICE 503-267-6064**

### Motorola/Radius Upgrades and Conversions

**GP-300/P-110 16 Channel Kits**  
• Complete kit \$44.95

Standard Programming and Repairs also available



**RadMax Communications**

**COMPLETE COMMUNICATIONS SERVICE**  
10677 Indianwoods Drive, Cincinnati, Ohio 45242  
513-489-1732

**cushcraft/Signals**

distributed by  
**Communications  
Associates Inc.**

(800) 435-9313

In Illinois (800) 892-1611

Order Fax (800) 284-4934

### UltraLink™ Cable

Designed for two-way and  
cellular applications, this  
heat-tolerant, low loss,  
Teflon® cable is the right  
size for your RG58  
connectors and the right  
price for your budget!

UltraLink™ Cable is part  
of every Cushcraft/Signals  
800 and 900 MHz antenna  
featuring low loss cable.

**CALL  
TODAY!**

Circle (89) on Fast Fact Card

## USED UNITS AVAILABLE

**FM/AM - 1200S**

with

Option 12: Tracking Generator

Option 15: Cellular Test

Option 09: Padded Case

Priced From



**FM/AM - 1500**

with

Option 03: Battery

Option 13: Padded Case

**\$5,500 to \$7,500**

**R.P. MOSES & CO. INC.** 516/679-8774 • Fax 516/679-9373  
Box 1102, Bellmore, NY 11710-0180

**• AUTHORIZED IFR DISTRIBUTOR •**

Circle (90) on Fast Fact Card

### \* RECONDITIONED \*

**MOTOROLA**

Mitrek, Micor, Maxar, Radius, Maxtrac

**800-231-0103**  
CALIFORNIA RADIO

### XPM SPECIALS

ICOM H16a-\$515 • U16a-\$525

Shinwa, Maxon, ICOM Marine &  
Nationwide Paging Service Available

Mastercard/Visa/Optima/AMEX

call **XPM (800) 753-4XPM**



## Classified

### ARIZONA

#### TWO WAY COMM.

MICOR RX (450-494)	\$40.00
TLE-8032	
MARATAC VHF 110W	350.00
T73XTA7TA7BK	
MASTER II VHF/UHF	
MC55CAU88A	75.00
MC56CAU66A	50.00
STANDARD MOBILE	50.00
40W 16-CHL HAM BAND	
MICOR T44 P.A. 45W	40.00
MICOR T54 P.A. 75W	50.00
MOT & G.E. PL REEDS	25.00

**1-800-377-3807**

### Why Electro Dynamics Crystal? Reliability and Dependability

LMR and Pager crystals for most models. For the best delivery, quality and price call: 1-800-332-9825.

**1-800-EDC XTAL.**

### ELECTRO DYNAMICS CRYSTAL CORP.

9075 Cody  
Overland Park, KS 66214

**NOT JUST ANOTHER CRYSTAL CO.**

## Equipment for sale

### RTX Corporation

**Advanced Turn-Key Trunking  
Radio-Telephone Systems  
Designed and Installed  
Anywhere • Any Frequency • Any Size  
RTX Puts You On The Air**

**1-800-848-4RTX**  
4000 Dow Rd., Melbourne, FL 32934

### IDA SYSTEM 3 PLUS

Current airtime billing software. Never used or configured. Call or send inquiries to:

**Graybill Electronics, Inc.**  
98 Emmons Street  
Hiawatha, IA 52233  
(319) 393-5456

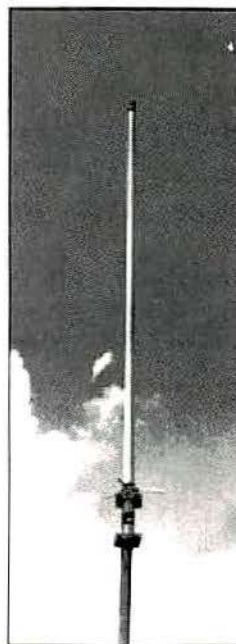
### LAND MOBILE RADIO BBS

Buy - Sell - Trade used radio equipment with hundreds of other dealers nationwide. Call with your modem to register now.

**The CommLine BBS**  
**313-854-6441**

## YOUR STOCKROOM HAS IT ...

**CELWAVE**   
DIVISION OF RADIO FREQUENCY SYSTEMS



## THE COMMUNICATIONS EXPRESS

US 1-800-631-7297

FAX 1-800-327-0007

Circle (92) on Fast Fact Card

### • PAGERS • PAGERS • "ONE CALL CAN GET IT ALL"

AT  
**McMANUS COMMUNICATIONS**  
NEW NEC AND PANASONIC PAGERS  
RECOND. PAGERS—ALL TYPES  
PLUS  
PARTS, BATTERIES, ACCES., ETC.  
!!! WE REPAIR PAGERS !!!  
**PHONE: 501-763-6250**  
**FAX: 501-763-6533**  
• PAGERS • PAGERS •

### WE BUY AND SELL USED MOTOROLA AND GE FM TWO-WAY RADIOS

- 1 MSF 5000 Rptr., 900MHz, C65F87206AT
- 47 MDSAR 800MHz, Trunked, D35TLA5G00
- 25 GE MARC V Portables, 800MHz, Trunked, P7B3C55SKM
- 1 MICOR Base, 800MHz, L35RTB6100
- 1 MSF 5000 Rptr., 460MHz, C74CLB7105AT
- 8 MICOR Rptr., 460MHz, C24RCB3105T
- 3 CONSOLETTTE Bases, 155MHz, L43BBB3100
- 8 GE MASTR PRO Bases, 72MHz, OC44EC555
- 26 MICOR, 495MHz, T74RTA3000
- 46 SYNTOR, 495MHz, T64SRA3200
- 30 MICOR, 460MHz, T74RTA3000
- 50 SYNTOR, 460MHz, T64SRA3200
- 9 MAXAR 80, 460MHz, D34TSA6000
- 10 MAXAR 80, 460MHz, D34TSA3000
- 23 MT500, 460MHz, H34BBU1210
- 116 HT220, 460MHz, H24FFN3110
- 21 MICOR, 173MHz, T53RTN3000
- 10 MAXAR 80, 173MHz, D43TSA3000
- 22 PULSAR II, IMTS TELCO, T1678
- 25 MITREK, 153MHz, T63JJA3000
- 134 MICOR, 153MHz, T73RTN3100
- 3 MT500, 155MHz, H33BBB3184
- 8 MINITOR I, 155MHz, H03EAB1212
- 26 MITREK, 48MHz, T81JJA2000
- 7 MOCOM 70, 48MHz, T71BBA1000
- 12 GE MASTR II, 48MHz, MC74CC533
- 9 MICOR, 48MHz, T51RTN1100
- 2 GE EXEC II, 31MHz, RT7AAAS13AH
- 50 MOCOM 10, 31MHz, D41AAN3100
- 28 DC Remote Desk Sets, T1376
- 10 DC Remote Consoles, T1377
- 15 Local Desk Sets, T1370

**SCHAEFER RADIO CO.**

1391 Grant • Box 395 • Denver, IA 59622 • (319) 984-6115 • FAX (319) 984-6220

### Buying? **PAGING** Selling?

Pagers • Equipment • Services

Use the **QUICKADS** Database

Call, via modem: 704-573-1740 (N-8-1)

Enter 192 for "Field of Interest"

### • MOBILES • BASES • PORTABLES • PAGERS • REMOTES •

#### PCI — PEKAAR COMMUNICATION INC.

Steve's back, formerly of Gregory Electronics Corp.

**\$ Specials of the month. \$**

GE Corona M6A43—800 Range USA 1 Beige	\$85	Motorola portables C23FFN1130 HT220 2 freq.	
GE ExecII table top base F155KAU89		slim line high bend	Special: \$50
470-490 range	\$175	GE MPR portables P2BRR56	
GE Phoenix mobiles N3A01 high bend		450-470 range single freq.	Special: \$88
crystal type	\$85	RCA Portable tac model HCA35DA 150 to	
GE Deltas crystal type N3HH high bend		170 range w/battery antenna & charger.	\$125
less acces.	\$65	GE Master Pro mobiles MT micom	
GE ExecII mobiles F155FGU89 40 watt		65 450-470 range w/acces.	\$98
470-490 range w/acces.	\$100	Motorola Mitrek T54JJA3000 450-470	
Motorola Mocom 70 mobiles U44BBN		range with acces.	\$250
450-470 or 470-490 range w/acces.	\$88	Motorola Portable MT500 H34 on 470-490 range	
GE PE portables PE65RAWXHX 470-490		w/battery and antenna	\$125
range as is, less icoms.	Special \$25	Regency BTH201 w/acces	\$45
Catalog Available		If you can't find it, try us!	Call (201) 772-0704

### • BOARDS • STRIPS • ACCESSORIES • ELEMENTS • REEDS •

800 ..... T43 Micors (8 frequency)  
400 ..... T43 Mitrec (12 frequency)  
400 ..... various IMTS  
10 ..... Maxtrac trunking  
20 ..... STX 800 trunking  
100 ..... repeaters—various

**Call for info 306-525-5512**

### Swersweep

#### SWR Measurement Kit

Swersweep is designed to work with modern service monitors with trucking generator and spectrum analyzer enabling a plot of SWR vs. Frequency on the CRT display. Swersweep allows the instrument to function as a scalar network analyzer. See feature article on page 64 of October 1989 *Mobile Radio Technology* for more information.

#### Uses:

- Tuning Antennas: Base, mobile, or glass
  - Tuning cavities, duplexers, or filters
  - Tuning preamps and Receiver front ends
  - Checking transmission line and trimming to resonance
- Each Swersweep is hand built with calibration traceable to the National Bureau of Standards.

1-500-MHz \$350, 1-1000 MHz, \$675

Prices include shipping.

#### Europa Marketing

2358 S. Patterson Mesa, AZ 85202  
Phone: 602-345-6666

Circle (94) on Fast Fact Card



## KRECO ANTENNAS

**Rugged** Co-Axial Antennas  
**All Grounded** For Lightning  
Protection  
**All Aluminum** for Light Weight

### HEAVY DUTY

Model CO-41A \$420.00 30 to 50 MHZ  
\$300.00 72 to 76 MHZ

### EXTRA HEAVY DUTY

Model CO-41H \$510.00 30 to 50 MHZ  
Model CO-41HTD \$750.00 Heated

**Manufactured to Your Exact Frequency**  
**Fast Delivery—Very Fast!**  
**Captive UHF Fitting (Type N \$6.00 Extra)**

### HERB KRECKMAN COMPANY

27 Spruce Cabin Road  
Cresco, PA 18326  
(717) 595-2212 • FAX (717) 595-2024

Circle (91) on Fast Fact Card

## Rentals

### MOTOROLA RADIO RENTALS

- MT1000, HT600, P200
- Intrinsically Safe
- All Types Headphones
- Mobiles & Portapacks
- Repeaters & Crossband Sets
- Dealer Inquiries Invited

**1-800-283-COMM**  
**EVENT RENTAL COMM., INC.**



**MOTOROLA**  
**RENTALS**

- GP300, P200, HT600
- Mobiles, Repeaters
- Intrinsically Safe
- Dealers Welcome

**1-800-822-MOSS**



**MOSS**  
COMMUNICATIONS



### GE WHOLESALE DISTRIBUTION CENTER

- Million Dollar Inventory
- Less than Wholesale Prices
- New and Used, Buy and Sell
- New Dealer Packages

1-800-336-6825



## RADIUS

WE'LL BEAT YOUR BEST PRICE!

California Radio 800-231-0103

*Publications*

## QUANTUM'S TECHNOLOGY LIBRARY

### THE CELLULAR RADIO HANDBOOK - Neil J. Boucher *Brand New and Expanded Second Edition*

The definitive reference text for the cellular industry just got much better. 42 chapters and over 300 illustrations explain in detail all aspects of cellular system planning and operation. Six new chapters on digital technology. 765 pages. Still \$185.00

### DATA OVER RADIO: Data and Digital Processing Techniques Geoff Varrall & Roger Belcher

NEW!! This complete reference on wireless data compares US, European and Pacific Rim options for analog and digital cellular and PCN in terms of their ability to deliver text, data and speech within defined power, spectral and cost constraints. Examines satellite performance for wide area applications. \$95.00

Other Wireless Technology Resources from Quantum:

**Paging Technology Handbook** - Just Published \$95.00

**Dual Mode Cellular** - \$95.00

**Mobile Radio Servicing Handbook** - \$59.95

**Cellular Telephone Installation Handbook** - \$49.95

**Cellular, Mobile Sat & Paging videos...Call!!**

### MOBILE RADIO ENGINEERING SOFTWARE

Two powerful and economical software packages for mobile radio engineers. **Cellular Engineer**, a sensational desktop tool, performs a wide variety of traffic engineering, forecasting and mobile radio engineering calculations. Only \$295.00! **Radio Survey Master** is a real-time, multi-channel, field strength measurement and statistical analysis tool for RF engineers. \$1,900.00 including A/D card.

**Quantum Publishing, Inc.** P.O. Box 310 Mendocino CA 95460  
Tel 1-800-422-9666 Fax 707-937-4489  
**DNA Communications** Brisbane Australia Tel 07-354-3444

Circle (100) on Fast Fact Card



**RADIO COMMUNICATIONS TECHNICIAN**

All American Pipeline Company, A CELERON company and a subsidiary of The Goodyear Tire & Rubber Company is seeking an experienced highly-qualified, highly-motivated FCC licensed Radio Communications Technician for our Operations Headquarters in Bakersfield, California.

This position involves the installation, maintenance and operation of our company radio communications equipment. This individual will insure compliance with all FCC and DOT regulations, while maintaining security and confidentiality of the telecommunication systems. This position requires frequent travel and on-call duty.

The successful candidate will have at least five years experience in the following:

Installation, routine maintenance and repair of G.E. and Motorola 800 MHz conventional repeaters, mobiles, base stations and portable. Installation, maintenance and operation of 2 & 6 GHz microwave and multiplex systems. PABX telephone systems, and commercial HF radio systems. Amateur radio experience would be a plus.

Members of our "Team" are rewarded with an excellent compensation and benefits package, including health, vision, dental, life and disability insurance, tuition assistance, 401(k) Plan, Pension Plan, vacation and sick leave benefits.

Send your resume in confidence to:

**All American Pipeline Company**  
ATTN: Telecommunications  
Department  
5500 Ming Avenue, Bakersfield, CA 93309  
**WE ARE AN EQUAL  
OPPORTUNITY EMPLOYER**

**TWO-WAY RADIO TECHNICIANS**

Growing Motorola Service Shop, in the beautiful Pacific Northwest needs qualified and experienced two-way radio technicians. Minimum 2 years experience servicing major brands. Must have strong employment history and FCC Certification. Excellent wages and fringe benefits. Equal Opportunity Employer.

Send resume to:

Clackamas Communications, Inc.  
Attn: Gordon Day, P.O. Box 22169  
Milwaukie, OR 97222

**Services**



**JEFA**  
INTERNATIONAL, INC.

**E F & I Turnkey  
Microwave & Two-Way Services**

Engineering  
System Design  
Equipment  
System Installation

1116 Dobie Drive 214-424-5680  
Plano, Tx 75074 214-423-5862 FAX

**Paging Two-way & Cellular  
Technicians Needed**

*Positions Available Nationwide*

Send resume, with area preference and salary requirement to address below. Fees are company paid.

**Permanent & Contract Personnel Available**

- Executive • Management • Marketing
- Sales • Engineering • Technical
- Extensive national resource of personnel



**Communication Resources**

The communication personnel specialists  
P.O. Box 141397 • Cincinnati, OH 45250  
606-491-5410/FAX 606-491-4340

**MANAGEMENT**

Growing Motorola Service Shop, located in the beautiful Northwest, is seeking candidates who demonstrate understanding of principles & practices of Two-Way Radio Repairs and Installations. Must have a minimum of 3 years management experience and be highly motivated; people oriented; well organized and able to work under pressure. Excellent benefits and competitive wage. Equal Opportunity Employer. Send resumes to: Clackamas Communications, Attn: Gordon Day, P.O. Box 22169, Milwaukie, OR 97222. No phone calls please.

**We FILL  
Communication Positions**

**Advancement Recruiting Services**

P.O. Box 620083  
Cleveland, Ohio 44102  
216-671-9910

**CAREER SEARCH?**

*We have the opportunities!*

Cellular / Wireless / PCS / Radio

Permanent & Consulting • Domestic & International

**E. J. DORT & ASSOCIATES**

P.O. Box 12546 • RTP, NC 27709-2546  
919-544-9476

**OREGON / WASHINGTON**

Looking for experienced salesperson willing to move to the beautiful Pacific Northwest. Must have 2-way radio experience. Only those with radio sales background need apply. Equal Opportunity Employer. Send resume to:

Personnel Manager  
P.O. Box 22169  
Milwaukie, OR 97222

**Services**

**Computer Resources Inc.**

The Service Management system is designed for the management of a mobile communications company. It provides the user with work orders, and work order history, inventory control and purchasing, contract management and costing, equipment management and costing, and technician productivity. Also available are Recurring Billing, SMR Billing, Pager Billing and Inventory, plus Accounts Receivable, Accounts Payable, General Ledger, and Payroll.

**205/987-1523**

**FCC License Preparation**

Fast, Easy, Home Study, Inexpensive.  
Land Mobile Handbook, New Employment Guide,  
Audio & Video Courses Available.

**FREE Details**  
**WPT PUBLICATIONS**  
1-800-800-7588

**STUDY LAND MOBILE COMMUNICATIONS  
AT HOME!**

38 lessons written exclusively for Mobile Communications Servicing. \$375.00. Call or write for free information:



P.O. Box 8278  
Lumberton, TX 77711-0278  
(409) 755-7338



**REPAIR & RETUNING  
OF  
DUPLEXERS**  
Filter Systems  
Rx Multicouplers

**!!! FCC FREQUENCY INFORMATION !!!**

Parts 90, 95 and 22

**Custom Reports: Marketing or Engineering—Your Geographic Area**  
Demographic & Boundary Information Available for report integration.  
**Database Updated Daily**

- Private Land Mobile Radio Services
- Common Carrier and Private Carrier Paging
- Cellular Licensees with Cell Sites
- SMRs—Trunked and Conventional
- VHF and UHF Control Links

**Output on diskette or 9 track tape (printouts also available) for easy analysis of your data:**

- Sort by your priority
- Identify potential customers
- Identify potential interference
- Locate transmitters
- Only the information fields you want
- Print mailing labels
- Identify used and unused frequencies

**Call or Fax your request for a FREE ESTIMATE**



**COMSEARCH**

Business Information Services—251 West Renner Road, Richardson, TX 75080  
**Phone: 214/680-1000 Fax: 214/680-9802**



## Services



• DEMO DISK upon Request:



## RADIO ENGINEERING PRODUCTS

Everything you need for Site Development and FCC Applications

### SOFTWARE

- 3-D Terrain
- Coverage Predictions
- Fresnel Zone Studies

Engineering Package  
Intermodulation  
Studies  
3 or 30 Second  
Terrain Files

### ENGINEERING SERVICES

Consulting  
Coverage Predictions

2-10 Mile H.A.A.T.

Frequency Selection  
Topographical Profiles

Intermod Study

### FCC INFORMATION

Dial Access  
State Frequency  
Lists  
Custom Searches

Mailing Labels  
Printouts

Data Files

### C.E.T. INC.

Orders: 800-445-0297  
FAX: 904-426-0014

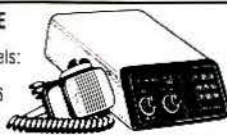
1001 S. Ridgewood Ave.  
Edgewater, FL 32132

Circle (97) on Fast Fact Card

## Repair services

### \$25.00 FLAT RATE

Plus Parts & Shipping  
On the following models:  
XLH-250 RH-250  
RH-256 WH-2516  
WH-2510 RFH-252  
UC-102 UC-202  
TRH-202



### REGENCY/WILSON

\*OTHER MODELS—\$25/HR Plus Parts & Shipping

### MULTICOM

2608 N. Moore Ave.  
Moore, OK 73160-3316

405-799-7356 800-880-7356 • VISA • MASTERCARD • COD

• FAST TURNAROUND

• FACTORY TRAINED

• VISA • MASTERCARD • COD

## E.J. RIEMITIS CO., INC.

Quality Service from the Most Experienced  
Midland Service Center in the Northeast!

Just call/fax to (508) 682-3572 for Return #



"The Pager Repair People"

High quality, cost effective, and guaranteed  
pager repair. Flat rate labor (plus parts and  
shipping) on Motorola, NEC, Panasonic and  
Shinwa.

(303) 337-4811 FAX (303) 337-3048

## TWO-WAY REPAIR \$30/hr\*

A.S.K. COMMUNICATIONS  
1-800-827-0747

\*Plus parts & shipping

### QUALITY REPAIRS

- MOTOROLA
- STANDARD
- UNIDEN
- JOHNSON
- MIDLAND
- AND MANY MORE!

MOBILES & PORTABLES,  
800 CONVENTIONAL

## BENDIX / KING

Authorized Service Center  
Repair Services for all your  
communications needs!

- FREE Estimates
- 90-Day Warranty
- Quick Turn-around
- FM / AM / SSB / CW
- Northwest Location

SKYLINE RADIO (503) 663-5858

## Repair services

"Tech Notes from a Telephone Engineer,"  
provides analysis, corrective measures for:  
Parameters • Noise • Lighting Protection  
• RFI • Fax • Modems • Calling Party  
ID • Answering Machines • Cable and more.  
Step by step testing guide for end users/tech-  
nicians and sources for special test equipment.  
Authored by technical support engineer, with  
illustrations. \$18.95 plus \$3.50 s&h to:

### db levels

P.O. Box 1125, Tallahassee, FL 32301-1125.

## CALL

SALES & SERVICE  
FOR NEW MODEL DEMOS

KNS ELECTRONICS, INC.  
2146 BERING DRIVE  
SAN JOSE, CA 95131

PHONE: 408-432-8100  
FAX: 408-432-8359

MODEL 7130  
TRACKING GENERATOR  
OFFSET GENERATOR  
1 GHZ GEN & REC  
SPECTRUM MONITOR  
ENCODER

## CUSHMAN



Circle (108) on Fast Fact Card

## SERVICE MONITOR REPAIR/CALIBRATION

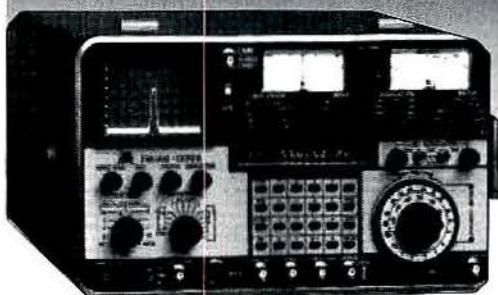
Specializing in Service Monitors since 1973

We buy and sell  
used monitors!

Phone (800) 288-8223  
or (310) 322-3566

COMMUNICATION  
INSTRUMENTS™

356 Hillcrest Street, El Segundo, CA 90245



Circle (98) on Fast Fact Card



**Triton  
Electronics, Inc.**

**SERVICE MONITOR  
REPAIR & CALIBRATION**

Exclusive monitor repair since 1973

**NIST TRACEABLE**

Cushman, IFR, Motorola, Marconi

4300 Lincoln Ave., Unit O

Rolling Meadows, IL 60008

(708) 934-6426 Fax (708) 934-7195

## LOUDOUN COMMUNICATIONS, INC.

Communications Systems  
REPAIR DEPOT

Microprocessor based Mobiles,  
portables, controlheads.  
GE Warranty Processing  
Fast turn-around



585 Factory Shoals Road  
Austell, GA 30001

404/948-9566



## RF Fuse Protector for IFR Service Monitors

- Fits models 500(A), 1200A/S and 1500
- Just \$90, postpaid, inc. 2 spare fuses
- Costs less than your first repair job!

COMMUNICATION  
INSTRUMENTS

Phone (800) 288-8223  
356 Hillcrest Street  
El Segundo, CA 90245



## Repair services

### NS ELECTRONICS SERVICE INC.

COMMUNICATIONS MONITORS SALES & SERVICE  
N.I.S.T. TRACEABLE CALIBRATION  
CUSHMAN IFR  
SALES NEW-USED

3610 Dekalb Technology Parkway  
Suite 110/111  
Atlanta, Georgia 30340  
(404) 451-3264  
Fax: (404) 458-8785

**CALL**

AUTHORIZED  
CUSHMAN SERVICE

For  
Classified  
Advertising  
information:  
Call  
Jennifer  
Hinkle  
913-967-1927

## Tower Services



### AMERICAN TOWERS AND STRUCTURES

- CELLULAR • MICROWAVE • UHF/VHF •
- BROADCAST • SPECIAL • COMPLETE
- INSTALLATION SERVICES • GUYED TOWERS •
- SELF SUPPORTING TOWERS •

FOR YOUR CATALOG CALL OR FAX

TOLL FREE PHONE FAX  
800-369-0159 712-252-0240 712-252-0371

## Tower space

John M. Rowe  
Communications Real Estate  
Site Acquisition, Site Marketing &  
Zoning Specialist  
1236 Corona #2  
Denver, CO 80218  
(303) 830-0815



### PRIME NORTHERN NEVADA SITES

Our newest, Pond Peak, at 8035' AMSL 2635' AAT, Overlooking Reno and Fallon and the I-80 corridor,

CALL NOW, 702-827-6060  
HIGH COUNTRY COMMUNICATIONS

### 37 CALIFORNIA ANTENNA SITES

- Major Locations • Stand-by power
- Secure facilities • Air Conditioning



Or develop your own site.  
Land available at  
Oat Mountain/Chatsworth.

### MERIDIAN COMMUNICATIONS

Since 1956

23501 Park Sorrenino, Ste. 213A

Colabasco, CA 91302-1355

Contact Rich or Jack Reichler at

818/888-7000

ARIZONA'S PREMIER  
TOWER FACILITIES  
Contact Dave or Charlie Bonifasi  
ANTENNA SITES, INC.  
602-451-7702

### SEATTLE AREA

Commercial power with generator backup.  
Good security. Year around access.

GOLDSPAR COMMUNICATIONS  
206-475-9430  
Fax 206-475-9410

### TOWER SPACE

Westchester • Putnam • Rockland  
Connecticut

Combiners 70-960MHz Bogner and Antel antennas 450-960MHz with downtilt and null fill. Satellite earth station antenna available. Emergency generator, A/C. Elev. over 1,000 ft. Easy access all year. Covers Westchester, Putnam, Rockland and parts of Conn. Contact Jerry Agliata.

SIGNAL TOWER COMPANY, INC.  
914-633-0569 • Fax 914-633-9315



TEL: (708) 823-7713

CHICAGO TOWER  
LEASING CORP.

COMMUNICATIONS  
TOWER & ANTENNA  
SITES FOR THE  
METROPOLITAN CHICAGO  
AREA

P. O. Box 31160  
CHICAGO, IL 60631

### NEED TENANTS??

Advertise your sites in the  
NATIONAL COMMUNICATIONS  
SITE DIRECTORY

Dedicated to advertising antenna sites for lease

### NEED SITES?

The NCSD contains hundreds of prime antenna sites across the Nation.

To get your copy write or call:

\*\*\*INTRAFAAM, Dept. M, P.O. Box 6093\*\*\*  
Freehold, NJ 07728 (908) 462-5964

# Free!

Here's the first step designed  
to save you time and money!

Whether you're a  
communications newcomer or  
an experienced pro, you'll find  
this handy booklet invaluable  
for:

- ✓Paging
- ✓Dispatch
- ✓Cellular
- ✓Broadcast
- ✓Personal or Business
- ✓Specialized Mobile
- ✓Satellite
- ✓Microwave
- ✓Telemetry
- ✓Data

When you need help in selecting a communications site, call the northern California experts. With 33 well-managed sites in key locations and a personable, dedicated staff, we'll get you up and on-the-air fast.



### DIABLO COMMUNICATIONS, INC.

1220 Brickyard Cove Road, Point Richmond, CA 94801  
(510) 236-3700, Fax (510) 236-3799 Ask for Mr. Pringle

### The California SITE SELECTION Check List

- The answers to—
- ✓Choosing a site
  - ✓FCC requirements
  - ✓Risks
  - ✓Leases
  - ✓Maintenance
  - ✓More

The California  
SITE SELECTION  
Check List  
(510)-236-3700  
Fax (510)-236-3799



## Equipment wanted

### Equipment Wanted

Motorola, Johnson, GE,  
EFJ, Uniden, Standard

**Buy-Comm-Co.**  
**1-800-347-4121**

**FAX (602) 585-6900**

## Business opportunities

### FOR SALE: MIDWESTERN 2-WAY RADIO COMMUNICATIONS DEALERSHIP.

Good customer base with very good potential for additional growth. Currently authorized Johnson, Uniden, Standard, Ritron and Kenwood. Many community repeaters and excellent local wide range SMR system. Serious inquiries only. Please reply to: Dept 920, Mobile Radio Technology, Box 12901, Overland Park, KS 66282.

## Computer software

## Identify and prevent communications site interference in minutes rather than hours.

Introducing ComSitePlus, PC-based software that combines the popular DeSensePlus™ and IntermodPlus™ to integrate Transmitter Noise/Receiver Desensitization with Intermodulation analysis. ComSitePlus picks up where most intermodulation programs leave off.

Automates looking up antenna spacing graphs, TX noise/RX desense curves, and RF filter curves. Calculates all signal levels and recommends additional isolation requirements. Works with all Land Mobile radio bands, 25-1,000 MHz.

# COMSITEPLUS™

BY DOUGLAS INTEGRATED SOFTWARE

For a brochure, call 1-800-845-0408. Individual communications site consultation available.  
1300 Executive Ctr. Dr., Ste 520 • Tallahassee, FL 32301



Circle (101) on Fast Fact Card

# TCS

### CONSULTING SERVICES

- Feasibility Studies
- Path Analysis
- Specifications
- License Assistance

### ENGINEERING AID SOFTWARE

- Microwave Calculations
- Multi-Point (SCADA)
- Topo Graph (Profiles)
- HAAT Calculations

30 Second & 3 Arc Second Data Bases Now Available

### TECHNICAL COMMUNICATIONS SOFTWARE

P. O. Box 884 Montgomery, TX 77356 • (409) 588-3200 • FAX (409) 588-4434

## The SENTRY "Service Manager"

The technicians very own encyclopedia of service department information. A collection of over 50 Programs, Charts, Formulas and Conversion Factors. Information required daily, now on your service shop computer.

Faster than looking it up in a book..

Send \$ 79.95 Check or Money Order to:

**SENTRY USA®**

P.O. Box 372416

Indian Harbour Beach, FL 32937-0416

Telephone (407) 773-6090 FAX (407) 773-6092

Circle (103) on Fast Fact Card

## ♦♦♦WANTED 900 LTR♦♦♦

Have for trade:

100 W-VHF Mitretrs  
20 W-UHF Mastr II  
35 W-800 Mitretrs  
4 W-UHF Saber-I-12F  
15 W-VHF Maxars  
50 W-LB Mastr II bases  
250 W-VHF Master II base  
8 line Mot remote T1617  
50 W-VHF Vee-TACS  
Sideband technology  
SSB VHF repeater & MO  
Spectras-Maxtracs & Mostars  
EFJ Select Call Console B/O

Ask for Dave

**510-895-9500**

**Fax 510-895-5722**

• P A G E R S • P A G E R S • P A G E R S •  
**WANTED TO BUY**  
**PAGERS**  
**McManus Communications**  
Phone: **501-763-6250**  
Fax: **501-763-6533**  
• P A G E R S • P A G E R S • P A G E R S •

### BUY & SELL

Used Duplexers

ALSO REFURBISHING & RETUNING.

*You don't pay if it won't tune.*

**DENNIS COMMUNICATIONS**

3181 Fulton • Abilene, TX 79605

CALL: 1-800-727-5657

## Radio Sites

### SET YOUR "SITES" ON US

WE can save you time and money. Call for a list of California's best kept secrets...805-945-5448.

*If you don't we both lose money.*

# FCC

## Database on CD-ROM



Search by Frequency  
Search by Licencee  
Print Mailing Labels  
FCC Database DC to Daylight

Advance Orders Being Taken  
**NOW**  
For First Quarter 93 Delivery

**Special Pre-Production Price**

For more information contact:

**OCEAN VIEW COMMUNICATIONS**

PO Box 15074  
Norfolk, VA 23511  
(804) 587-8251


Circle (102) on Fast Fact Card

**GET THE EDGE**  
**OVER YOUR COMPETITOR**  
ADVERTISE IN  
**MOBILE RADIO TECHNOLOGY**  
**CLASSIFIEDS**


Call Jennifer Hinkle at  
913-967-1927 Fax 913-967-1901



<b>COMPUTER ENGINEERING OF MICROWAVE SYSTEMS</b> (CEMS)	
<b>LAND MOBILE RADIO COVERAGE</b> (LMRC)	
<b>MICROWAVE</b> <ul style="list-style-type: none"> <li>• Menu Driven - Color Coded</li> <li>• On-Screen Path Profile Design</li> <li>• Diffraction Loss Calculations</li> <li>• Reflected Signal Analysis</li> <li>• Route and System Diagrams</li> <li>• Map Crossings - Graphic with Dimensions</li> <li>• Performance Predictions: Analog, Digital and Video</li> </ul>	<b>LAND MOBILE RADIO</b> <ul style="list-style-type: none"> <li>• Coverage Diagrams</li> <li>• Multiple Prediction Models</li> <li>• 300 Radios - 50 Mi (80 Km) Radius</li> <li>• Relief Maps in Color</li> <li>• Intermodulation Calculations</li> <li>• 800 Tx and Rx Frequencies</li> <li>• Up to 2<sup>nd</sup> Order</li> <li>• Graphic Presentations</li> </ul>
<b>NORTON ENGINEERING</b> 10002 McDuff Court Vienna, VA 22181 (703) 938-5745 Fax: (703) 938-9168	Demo Disk and Sample Printouts Available



Circle (104) on Fast Fact Card



Richard L. & Richard P. Bay  
Principals

CDS offers you the tools to predict radio propagation coverage with unprecedented accuracy. CDS Real World Propagation™ Studies are an invaluable tool used in the design of RF communication systems. Call us to discuss how we can supply you with the resources you need. Other RF Engineering Tools™ include:

- Online/Remote Access Services
- FCC & FAA Databases
- 3 Arc Second Terrain Data
- 1990 Population Data

**Communications Data Services, Inc.**  
 6105-E Arlington Blvd., Falls Church VA 22044  
 (703) 534-0034 • (800) 441-0034

Circle (105) on Fast Fact Card

**Terrain Analysis Package (TAP)™**  
**PC-based software for RF studies**

- Area field strength coverage maps.
- Shadow maps.
- Choice of propagation models.
- Point-to-point/microwave fade margin and reliability calculations.
- User-customized data base for buildings and vegetation.
- Digital elevation data on floppy disk or CD-ROM.
- Intermodulation product studies.

**SoftWright**  
 Limited Liability Co.  
 1010 South Joliet  
 Suite 204  
 Aurora, Colorado 80012  
 (303) 344-5486  
 FAX (303) 344-2811

**Free demo disk upon request.**

**Pyramid Communications**

**Service Management Software**

Version 3.0  
Only \$279



Free Demo & Manual

Inventory Serial #'s  
Shop Equip Part  
Radios Shop History

Mailing labels  
Kits Productivity Reports  
Customer Data Repairs

Order Release

Invoices

210 Main St #153 Seal Beach CA 90740 (414) 730-4190

## SCADA Software

**TURBEX-2** for water quality, waste water and general site monitoring and control using ZETRON equipment via packet radio.

**AgZax** for agricultural monitor and control using packet radio.

**CYCURE** turnkey site security monitoring system, auto alpha paging, billing and invoice system, uses ZETRON Mod 17 and 2000 series.

## TECHNICAL AND ENGINEERING

**TDEX2** path, propagation, terrain analysis, contours, area, shadowing, workstation interface.

**IMSITE V 3.10c** intermod and general interference analy. includes small expert system, worlds fastest, hands down, no excuses.

**OMEGA5 PE's** Intermod prm. includes IMSITE.

## SERVICE SHOP AND BILLING

**CYRNET** service shop oper. system, recurrent billing, terminal equipt. download, interface and conversion, autopricing from mfg. data or inventory, FIFO or LIFO, service history tracking, numerous reports, good management, tech utils, highly configurable system for PC networks.

**CYR-XCHANG/DID-Tracer** turnkey answering service with AR and billing for PC networks.

**Updates Available—  
Please Call**

**Full BBS Support**  
**CyberSym Control Systems**  
 P.O. Box 227  
 Blacksburg VA 24063  
 703-268-5400 Voice  
 703-268-9767 BBS

Circle (106) on Fast Fact Card



# A Few Good Reasons to Choose **Micro-Quick** Software

5.  
futu.  
packa  
system  
SMR, PCP  
subscribers  
specific rate stru  
and terminal inter  
zones • 1st minute,

**GENERAL FEATURES:** Highly integrated telemarketing, lead-tracking, proposal generation, SO, PO, AR, AP, GL, Payroll, dispatch scheduling, recurring billing and report generation modules • Up to 99 user-owned companies, with up to 999 departments and 2600 locations, each • Comprehensive password protection • Over 2.1 billion user-defined customer and vendor numbers • 6 user-defined customer reporting fields • Up to 46,000 employees • Automatic GL linking • Pop-up help screens • Built-in UNIX/XENIX, UNIX, VMS, ULTRIX, AIX and SUN operating systems. **PROTOCOL:** Includes sales/service order entry, purchasing and accounts receivable modules • Complete customer service facilities • Express menu provides direct access to hundreds of daily functions • Over 2,000 user-defined reports • 15 character user-defined item numbers • Up to 2600 serialized/non-serialized inventory locations per company • 8 user-defined price levels + exchange price and minimum selling price • 5 user-defined cost levels + sales cost and exchange cost • Package pricing • Package costing • Customer-specific special pricing • Item-specific special pricing • User-defined reorder points • Automatic parts requisitioning • Automatic substitutions • Automatic stock transfers • Automatic bar-code indexing • Direct importing of pricing disks from Motorola, GE, Johnson, and others • Unlimited user-defined global pricing • 1296 sales tax codes, with 10 taxes each • 1296 user-defined terms codes • Unlimited customer, employee & inventory memos • Point of sale & cash drawer support • Automatically processes warranty claims and bills vendors • Automatic maintenance contract processing • Recurring maintenance contract billing • Tech productivity reporting • Sales commission reporting • Unlimited customers can be billed to a single account • 2700 line items per order • Orders can be entered by item number or description • On-line warranty and maintenance contract activations • Tracks up to 296 characters of system data, per serial number • Automatic job costing • Allows partial invoicing • supports multi-customer billing, from a single order • Automatically calculates UPS shipping charges • Automatically prints UPS COD tags • User-defined service alert periods • Unlimited user-defined failure codes • Unlimited user-defined fix codes • Serial number tracking by customer make, model, and 2 user-defined fields • Tracks customers by territory, lead source, travel zone, tax rate, terms code and SIC code • Automatic dispatch scheduling, based on 100 tech qualification codes and 2600 travel zones • FAX SO transmission • Prints unlimited service order, job card, PO, invoice, pick-list, statement and stock transfer copies • Dynamically updated tech calendar, work schedule and service status screens • Automatic service follow-ups • Automatically handles trade-ins, discounts and re-work • Complete return to stock and return to manufacturer inventory tracking • Allows perpetually open POs • Supports economic order quantity • Allows the creation of multiple POs from an open requisition list • Automatically prints/displays received PO distribution list • Full bar-code support • Supports recurring POs • FAX PO transmission • Individual & list-style cash receipts • User-defined aging periods • Comprehensive sales tax reporting • Cash drawer report • Tracks security and order deposits • Recurring billing. **E-XCEL:** Includes telemarketing, lead tracking & proposal generation • Supports over 2 trillion automatic & user generated lead numbers • Allows up to 99,999 contact sequences per lead • Tracks leads by lead number, customer number, name, address, contact name, phone number, telemarketer and follow-up date • Uses PROTOCOL customer, inventory, and pricing records • Dynamically updated appointment calendar • Daily appointment reports • Tracks average lead processing time & average days to close • Uses probability of close to project future income and inventory requirements • Productivity by telemarketer, salesperson and lead source • Prints to both quote forms and user-defined letterhead • Integrates with Word and WordPerfect mail-merge • Automatic future & periodic follow-ups • Supports up to 10 million active quotes • 99 user-defined quick-quotes • 10 user-defined telemarketing quotes • Unlimited packaged quotes • Unlimited quote text • 20 recalculate modes • Credit approval facilities • Comprehensive telemarketer compensation system • Automatic sales commission calculation • Quotes can be directly exported to PROTOCOL • Provides over 250 reports. **OPTIMA II:** Includes SMR, PCP, RCC, MSA, RSA, TAS, voice mail & flat-rate recurring billing • Supports over 60 million systems • 1.6 million networks • 2.1 billion subscribers • Supports up to 4,000 user-defined rate codes per system • And up to 4,000 user-defined rate groups per system • Unlimited unit-specific rate structures • 1296 special toll, pro-rate and commission codes per system • 6 user-defined time zones per system • Direct controller, switch & terminal interfaces • Automatic data uploads and downloads • Automatic call record import and rating • Per minute toll rating, in up to 6 time zones • 1st minute, 2nd minute and 3rd minute toll rating, in up to 6 time zones • Tiered pricing • 16 billing detail levels • per unit, per system & per network free minute trickle-down • Minimum per call charges • User-defined incomplete call discard times • Auto-adds up to 999 units • By-agent number inventories • Comprehensive agent commissioning • Rental inventories • Auto-depreciation • Bills in any language or currency • Add-delete revenue and loading reports • on demand invoicing • Time/date stamped number exchanges • Automatic pro-rate invoicing • Multiple billing cycles within a single rate group • Unlimited trial billings • Supports global credit holds and activations/deactivations • Concurrent and double-sided laser printing support • and lots more!

prints • Automatic r  
disks from Motorola  
terms codes • 11  
and bills ven  
sion report  
tion • 1  
partir  
for



# ...Now, for the Five Best Reasons

- 1. FREE DEMO SOFTWARE...** That's right, you can take a full-blown, all-out, no-holds barred test drive, absolutely free!  
In fact, if you go on one of our personal Demo Tours, we'll give you up to \$1,500 in purchase credits, just for taking the time!
- 2. \$3,000.00 TRADE-IN...** Why live with software that doesn't do the job? Trade it in on PROTOCOL, E-XCEL or OPTIMA II, and we'll give you a purchase allowance of one thousand dollars per module. - That can quickly add up to a \$3,000.00 windfall!
- 3. ONE STOP SHOPPING...** In addition to software, we can supply all of the components necessary to integrate your existing hardware & data into a powerful multi-user management system.  
In fact, we can even include on-site training and 24 hour service, all for one single price or monthly lease payment!
- 4. SATISFACTION GUARANTEE...** Our exclusive ninety day satisfaction guarantee ensures that your decision to choose Micro-Quick is always the right one!
- 5. TOTAL SUPPORT...** All Micro-Quick products include one full year of toll-free telephone support and free updates. We also include UNITRIX V, a one key-stroke solution to the management of users, terminals, printers, modems and tape back-ups.  
So, even if you know absolutely nothing about computers, the help you need is just a phone call or key-stroke away!



10535 Foothill Blvd. • Suite 230 • Rancho Cucamonga, CA 91730 • (800) 874-7749 • (714) 980-1034 • FAX (714) 944-3995

***Intelligent software, for Managers who take their business very seriously.***

Circle (107) on Fast Fact Card



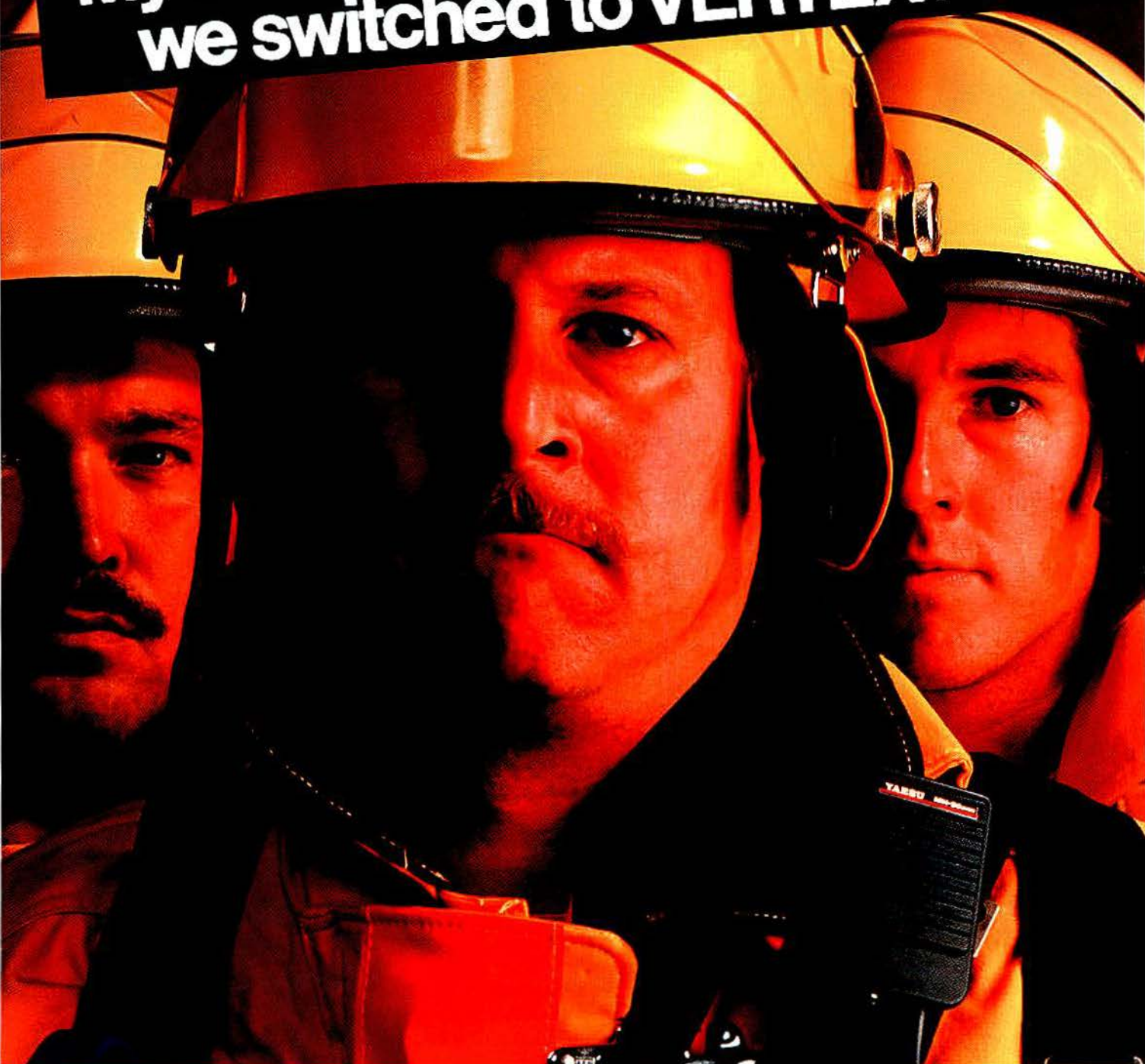


## *d index/hot line*

Company	Page Number	Fast Fact Number	Advertiser Hot line	Company	Page Number	Fast Fact Number	Advertiser Hot line
Advanced Reciver Research	28	23	203-582-9409	Midian Electronics, Inc.	43	38	602-884-7981
Air Comm	74	77	602-275-4505	Midland International LMR	IFC	1	800-MID-LAND
The Antenna Specialists, Co.	70	64	216-349-8400	Mobile Mark, Inc.	34	29	800-648-2800
Astron Corp.	41	36	714-458-7277	Modular Communication System	53	48	818-764-1333
Automation & Electronics Engr	76	83	800-527-4596	R.P. Moses & Co., Inc.	78	90	516-679-8774
Bomar	22,74	18,78	800-526-3935	Motorola Government	55	67	800-235-9590
California Radio	75		800-231-0103	Multiplier Industries Corp.	38	33	800-642-2424
Celwave	18-19	15	800-321-4700	MX-COM, Inc.	7	8	919-744-5050
Centurion International, Inc.	9	7	800-228-4563	New Mar	57	53	714-751-0488
C.E.T., Inc.	82	97	800-445-0297	Norcomm Corp.	20	16	916-477-8400
Chargeguard Corp.	75	79	800-458-3410	Norton Engineering	85	104	703-938-5745
Cimarron Technologies	25	20	800-487-7184	Ocean View Communications	84	102	804-587-8251
CML Technologies, Inc.	45	41	819-778-2053	Orbacom Systems, Inc.	31	26	609-829-4455
Coded Communications	17	14	800-228-6367	PanaVise Products, Inc.	16	13	702-353-2900
Communications Associates	78	89	800-435-9313	Pekaar Communication, Inc.	79	94	201-772-0704
Communications Data Services	85	105	800-441-0034	Positron Industries, Inc.	59	57	800-443-3313
Communication Instruments	82	98	800-288-8223	Procomm	76	93	805-497-2397
Communications Specialists	BC	3	800-854-0547	Quantum Publishing, Inc.	80	100	800-422-9666
Comsearch	81	96	214-680-1000	Radio Express, Inc.	76	85	703-266-1928
COMTELCO Industries, Inc.	62	59	800-634-4622	Ramsey Electronics	75	81	716-924-4560
Connect Systems, Inc.	13	10	800-545-1349	Santa Fe Distributing	63	60	913-492-8288
Control Signal Corp.	14	11	303-989-8000	Scala Electronic Corp.	51	46	503-779-6500
CPI Communications, Inc.	26	21	800-869-9128	Schlumberger Technologies	23	19	800-225-5765
Cushcraft/Signals Corp.	21,58	17,56	800-258-3860	Securiton Company	60	58	408-263-6434
Cushman/KNS Electronics	82	108	408-432-8100	Selectone Corporation	3	5	800-227-0376
Cybersym Control Sys	85	106	703-268-5400	Sentry Services Int'l	84	103	407-773-6090
Data Signal, Inc.	40	35	912-883-4703	Sharp Communication	77	88	800-548-2484
Decibel Products, Inc.	29	24	214-631-0310	Shure Brothers, Inc.	47	42	800-255-HURE
Diablo Communications, Inc.	83	99	510-236-3700	Simrad, Inc.	65	50	800-426-5565
D&L Communications, Inc.	58	55	219-484-0466	SMC Electro-Mount	30	25	800-527-1079
Doppler Systems, Inc.	69	61	602-488-9755	Softwright	85		303-329-6388
Douglas Integrated Software	84	101	800-845-0408	Solar Electric Specialties	56	52	707-459-9496
Eagle Wichita	67	63	316-942-5100	Southern Computer Corp.	77	88	800-752-3571
Frequency Management	75	80	800-800-9825	Standard Communications	39	34	800-767-6695
General Communications	76	84	800-356-3200	Statistical Control Systems	42	37	813-954-8816
Gilcris Corp.	15	12	804-784-2337	Sti-Co Industries, Inc.	32	27	716-662-2680
Doug Hall Electronics	66	62	614-261-8871	Tad Radio	48	39	509-326-1511
Henry Radio	46	43	800-877-7979	Tait Electronics USA, Inc.	12	9	713-984-8684
Hutton Communications	36	31	800-442-3811	TEAC America, Inc.	49	44	213-726-0303
Hy-Q International	77	86	606-283-5000	Telepoint, Inc.	71	65	310-289-0222
ICOM America	35	30	206-454-8155	Telex Communications, Inc.	50	45	612-887-5530
IFR Systems, Inc.	33	28	316-522-4981	Tower Structures, Inc.	52	47	619-421-1181
JaBRO Batteries, Inc.	54	49	800-323-3779	Transcript International Ltd.	5	6	800-228-0226
Herb Kreckman Company	80	91	717-595-2212	VCP International, Inc.	56,57	51,54	800-527-9366
Leathersmith	69	66	800-233-0440	Vega, A Mark IV Company	1	4	818-442-0782
Maxrad, Inc.	27	22	800-323-9122	Vertex/Yaesu USA	IBC		213-404-2700
Mechem Electronics	73	75	703-373-3888	Vocom/RF Corporation	48	40	800-USA-MADE
Meridian Comms-Comms Express	79	92	800-631-7297	Zetron, Inc.	37	32	206-820-6363
Micro-Quick Systems, Inc.	86-87	107	800-874-7749				



# My communication is critical-- we switched to VERTEX!



You don't need an emergency for dependable transmitting and receiving to be critical. VERTEX believes it's necessary all the time. With 35-plus years of radio communications leadership, our reputation for high-tech innovation and rugged reliability is well-known.

VERTEX delivers superior UHF,

VHF and Low-Band Mobiles and Handhelds backed by a 3-year warranty, competitively priced – without sacrificing quality, no matter what your budget.

For details on the VERTEX VHF/UHF compact handhelds, complete 4, 12/24 and 99 channel mobile line and our exclusive dual-

band handheld with MIL STD 810 C/D and FCC Part 80 see your nearest VERTEX dealer or call today!



**vertex**  
RADIO COMMUNICATIONS



• United States – (310) 404-2700, Yaesu U.S.A. • Central & So. America – (305) 593-2500, Yaesu Int'l Sales • Canada – (800) 567-6664, Omni Provincial Electronics  
© 1992 Yaesu U.S.A., 17210 Edwards Rd., Cerritos, CA 90701 Specifications subject to change without notice or obligation.





# Catch of the day!

Have you been trawling the bounding main for a new product? We have just netted it—the TP-38 microprocessor controlled community repeater panel which provides the complete interface between the repeater receiver and transmitter. Scuttle individual tone cards, all 38 EIA standard CTCSS tones are included as well as time and hit accumulators, programmable timers, tone translation, and AC power supply at one low price of \$595.00. The TP-38 is packed like a can of sardines with features, as a matter of fact the only additional option is a DTMF module for \$59.95. This module allows complete offsite remote control of all TP-38 functions, including adding new customers or deleting poor paying ones, over the repeater receiver channel.

Other features include CMOS circuitry for low power consumption, non-volatile memory to retain programming if power loss occurs, immunity to falsing, programmable security code and much more. The TP-38 is backed by our legendary 1 year warranty and is shipped fresh daily. Why not set passage for the abundant waters of Communications Specialists and cast your nets for a TP-38 or other fine catch.



**\$595.00 each**  
**\$59.95 DTMF module**  
**\$149.95 DCS module**

**COMMUNICATIONS SPECIALISTS, INC.**  
 426 West Taft Avenue • Orange, CA 92665-4296  
 Local (714) 998-3021 • FAX (714) 974-3420  
 Entire U.S.A. 1-800-854-0547



Outside USA or Canada: Jescom International / 1 Waters Park Dr. #117 / San Mateo, CA USA / Phone (415) 574-1421 / FAX (415) 574-5297 • Also in Italy and Spain

Circle (3) on Fast Fact Card